अखिल भारतीय समन्वित खरपतवार प्रबंधन अनुसंधान परियोजना

All India Coordinated Research Project on Weed Management

वार्षिक प्रतिवेदन

ANNUAL REPORT

2023

भा.कृ.अनु.प.–खरपतवार अनुसंधान निदेशालय, जबलपुर
ICAR-Directorate of Weed Research, Jabalpur
ISO 9001:2015 Certified

தினமலர் கோயம்புத்தூர் / சனி / 26.8.2023

பல்கலையில் விழிப்புணர்வு

सत्ता सुधार

सेवार्थ पाठशाला में गाजर घास जागरूकता सप्ताह मनाया

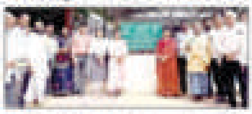
தினகரன்

ஆகஸ்ட் 26, 2023 சனிக்கிழமை

வேளாண் பல்கலை.யில் பண்ணை தொழிலாளர்களுக்கு பார்த்தீனியம் களைச்செடி விழிப்புணர்வு

राज एक्सप्रेस

किसानों व कृषि वैज्ञानिकों की मेहनत से मैथाना गांव हुआ गाजर घास मुक्त



चार चरणों में हुआ कार्य

इनका कहना है

ਪੀ. ਏ. ਯੂ. ਨੇ ਪਰਾਲੀ ਦੀ ਸਾਂਭ-ਸੰਭਾਲ ਲਈ ਸਰਫੇਸ ਸੀਡਰ ਮਸ਼ੀਨ ਲਈ ਚਾਰ ਨਿਰਮਾਤਾਵਾਂ ਨਾਲ ਕੀਤਾ ਕਰਾਰ

ਮਨਸੂਰਾਂ ਵਿਖੇ ਗਾਜਰ ਬੂਟੀ ਦੀ ਰੋਕਥਾਮ ਸਬੰਧੀ ਜਾਗਰੂਕਤਾ ਹਫਤਾ ਮਨਾਇਆ

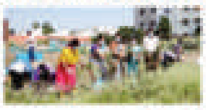
ਪੰਜਾਬੀ ਜਾਗਰਣ

ਗਾਜਰ ਬੂਟੀ ਜਾਗਰੂਕਤਾ ਸਮਾਗਮ ਕਰਵਾਇਆ

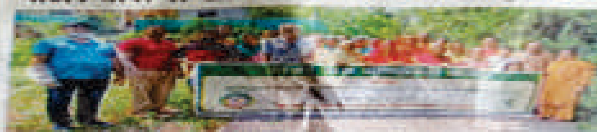
हिन्दुस्

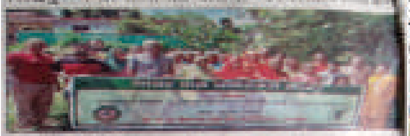
फसलों को 40% तक क्षति पहुंचा रही है गाजर घास

पंत विवि में गाजर घास के नुकसान और उन्मूलन के बारे में जानकारी दी



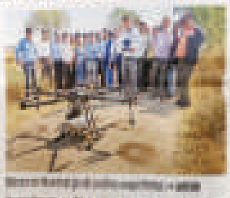
गाजर घास से खाद बनाने की विधि बताई





ड्रोन से किया कीटनाशक का छिड़काव, बताए इसके फायदे

किसानों को बताई कृषक ड्रोन की उपयोगिता



'कृषक ड्रोन' का गुल्लू में किया जीवंत प्रदर्शन

मैट्स वि.वि. के एग्रीकल्चरल इंजीनियरिंग विभाग का आयोजन

गाजर घास जागरूकता सप्ताह संपन्न

कृषि विश्वविद्यालय

गाजरघास से होने वाली हानियां बताईं

अखिल भारतीय समन्वित खरपतवार प्रबंधन अनुसंधान परियोजना

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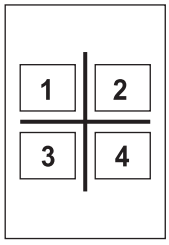


1. Weed management in finger millet by application of pyrazosulfuran-ethyl 15g/ha as PE *fb* metsulfuron methyl + chlorimuron ethyl 4 g/ha a PoE.
2. Mulching interspaces of coconut trees using Oushadhi waste for weed management.
3. Knapsack sprayers were distributed to Farmers under SCSP Programme at Ismailpur Kothey, Bishnah Jammu on 09-08-2023.
4. Front-line Demonstration Trial on Weed management in rice.

Preface

Weed interference is one of the major threats into agricultural and natural ecosystems for declining agricultural production and biodiversity. Although conventional weed management systems using herbicides and weeding tools provide some level of weed management, they often require repeated use or integration depending upon the weed pressure, crop competitiveness and management practices. Repeated use of some herbicides may encourage herbicide resistance development in weeds. Innovations in weed management approaches are therefore urgentlyneeded to help farmers and other stakeholders with more economicaland environmentally sustainable methods of weed management.Efforts are being made through All India Coordinated Research Project on Weed Management (AICRP-WM) to develop integrated weed management technologies to reduce crop losses due to weeds and increase the productivity and farmer'sincome.Since its inception in 1978, AICRP-WM has been carrying out the location-specific research on weed management with its 24 cooperating centres (17 regular and 7 voluntary) throughout the country.

I am happy to present the Annual Report of the AICRP-WM for the year 2023, highlighting the major research achievements and activities. During the year, emphasis has been given ondeveloping sustainable weed management in conservation agriculture-based cropping systems,weed management in direct-seeded rice, wheat, maize, vegetables, plantation crops, etc., management of herbicide-resistant weeds in wheat, management of invasive and parasitic weeds,estimation of herbicide residues in soil, water and crop produce,and on-farm research & demonstrations to refine and disseminate improved weed management technologies for ensuring wider adoption. In addition, emphasis has been given on identification of Weeds of National Importance (WONI), mapping of aquatic weed infestation in the country, spread of Phalaris minor resistance in wheat in Punjab and Haryana, and impact assessment of weed management technologies, and capacity building of the stakeholders using modern information technological tools.

During the year 2023, the AICRP-WM has published a total number of 63 research papers, 13 book chapters, 05 books, 12 technical/extension bulletins and 32 popular/technical articles. For the benefit of farmers and other stakeholders, 35 training programmes and 480 Front Line Demonstrations, 120 On-Farm Trials, 20 Radio talks, 06 TV programmes and 05 Kisanmelaswere organized. A countrywide Parthenium Awareness Programme during 16-22 August 2023 was also organized by all the Centres. In addition, 65 number of Package of Practice on weed management were developed by different centres, and 66 M.Sc. (Ag.) and 52 Ph. D. students completed their research work and submitted the theses under AICRP-WM.

I profusely thank Dr. Himanshu Pathak, Secretary, DARE and Director General, ICAR for his constant guidance and support in executing this project successfully. The encouragement and guidance provided by Dr. S. K. Chaudhari, DDG (NRM), and Dr. Rajbir Singh, ADG (A, AF&CC) are duly acknowledged.I wish to compliment the efforts of Dr. R.P. Dubey, Principal scientist & Incharge, AICRP-WM, for coordination, monitoring and evaluation of the technical programme. The contributions and cooperation of the Principal Investigators & Scientists from the cooperating centres is duly acknowledged. All the programme leaders, scientists and officials of the ICAR-DWR and AICRP-WM deserve appreciation for providing their invaluable inputs. I congratulate editorial team for bringing out this publication.

(J.S. Mishra)
Director
ICAR-DWR, Jabalpur

Contents

कार्यकारी सारांश

EXECUTIVE SUMMARY

खरपतवार प्रबंधन पर अखिल भारतीय समन्वित अनुसंधान परियोजना (एआईसीआरपी–डब्ल्यूएम) विभिन्न कृषि–जलवायु क्षेत्रों के तहत राज्य कृषि विश्वविद्यालयों में 17 नियमित केंद्रों और 7 स्वैच्छिक केंद्रों के माध्यम से अपने नेटवर्क अनुसंधान कार्यक्रम का समन्वय करती है। वर्ष 2023 के दौरान प्रमुख उपलब्धियाँ नीचे दी गई हैं

डब्ल्यू पी 1- खरपतवार प्रबंधन की स्थान–विशिष्ट टिकाऊ प्रथाओं का विकास

- पंतनगर में चावल–गेहूं–हरी खाद फसल प्रणाली में संरक्षित जुताई के तहत डीएसआर (सीटी+आर)–गेहूं (सीटी+आर)– हरी खाद (सीटी+आर) के साथ उच्चतम गेहूं अनाज उपज (4.7 टन/हेक्टेयर) प्राप्त की गई, इसके बाद डीएसआर (जेडटी+आर)–गेहूं (जेडटी+आर)–हरी खाद (जेडटी+आर) का स्थान रहा। खरपतवार प्रबंधन उपचारों में क्लोडिनाफॉप+एमएसएम 64 ग्राम/हेक्टेयर (30 डीएएस) के बाद एचडब्लू (45 डीएएस) ने उच्चतम अनाज उपज (4.8 टन/हेक्टेयर) दर्ज की।

- पंतनगर में डीएसआर पद्धति में (सीटी+आर)–गेहूं (सीटी + आर) – हरी खाद (सीटी + आर) और डीएसआर में (जेडटी + आर) – गेहूं (जेडटी + आर) – हरी खाद (जेडटी + आर) के साथ अनाज उपज (3.3 टन/हेक्टेयर) प्राप्त की गई। खरपतवार प्रबंधन उपचारों में पेंडीमेथालिन 678 ग्राम/हेक्टेयर (2 डीएएस) के बाद बिसपायरीबैक सोडियम 25 ग्राम/हेक्टेयर (20 डीएएस) के बाद हाथ से निराई (40 डीएएस) के बाद खरपतवार बीज की कटाई से सबसे अधिक अनाज उपज (3.9 टन/हेक्टेयर) दर्ज की गई।

- उदयपुर में, सोयाबीन आधारित फसल प्रणाली के अन्तर्गत, सोयाबीन में, पेन्डिमेथालिन + इमाजेथापायर 1000 ग्रा./हे. (बुआई के 2 दिनों के बाद) के बाद निदाई (बुआई के 30 दिन पश्चात) के बाद खरपतवार बीज कटाई अर्थात आईडब्ल्यूम में, बिना खरपतवार नियंत्रण किये गये प्लाट कि तुलना में बीज उपज (1.6 टन/हे.) और पुआल उपज (2.3 टन/हे.) प्राप्त हुई।

- ग्वालियर में, मक्का – चना फसल प्रणाली में टोप्रामेजोन को अंकुरण के पश्चात (बुवाई के 20 दिनों के बाद) 25.2 ग्रा./हे.

The All India Coordinated Research Project on Weed Management (AICRP-WM) Coordinates its network research programme through 17 regular centres and 7 voluntary centres at SAU's under different agro-climate Zones. The salient achievements during the year 2023 are given below:

WP 1. Development of location-specific sustainable weed management practices

- At Pantnagar in rice –wheat -legume cropping system under establishment method highest wheat grain yield (4.7 t/ha) achieved with DSR (CT +R)-wheat (CT +R)-GM (CT +R) followed by DSR (ZT+R)-wheat (ZT+R)-GM (ZT+R). Among weed management treatments clodinafop+MSM 64 g/ha (30 DAS) *fb* HW (45 DAS) recorded highest grain yield (4.8 t/ha).

- At Pantnagar in direct-seeded rice grain yield (3.3 t/ha) achieved with DSR (CT +R)-wheat (CT +R)- GM (CT +R) and DSR (ZT+R)-wheat (ZT+R)- GM (ZT+R). Among weed management treatments pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest recorded highest grain yield (3.9 t/ha).

- In soybean under soybean-based cropping system, PE application of pendimethalin + imazethapyr 1000 g/ha (2 DAS) *fb* HW (30DAS) *fb* weed seed harvest i.e., (IWM) resulted in enhancement of seed and haulm yield over weedy check and highest seed yield (1.6 t/ha) and haulm yield (2.3 t/ha) obtained in this treatment at Udaipur centre.

- At Gwalior, in maize-chickpea cropping system, topramezone 25.2 g / ha as PoE (20 DAS) resulted in the

छिड़काव के परिणाम स्वरूप खरपतवारों का अधिकतम नियंत्रण हुआ और चने की अधिकतम दाने और स्टोवर उपज प्राप्त हुई।

- उदयपुर में, मक्का – चना फसल प्रणाली में चने में टोप्रामेजोन 25.2 ग्रा./हे. के रूप में अंकुरण के पश्चात बुआई के 10–15 दिनों बाद एवं बुआई के 20 दिनों बाद प्रयोग करने से अधिकतम बीज उपज (1.9 टन/हे.) दर्ज की गई ।

- ग्वालियर में, संरक्षित जुताई के अंतर्गत, मक्का आधारित फसल प्रणाली में शून्य जुताई के साथ फसल अवशेष के प्रयोग से खरपतवारों पर नियंत्रण होता है साथ ही साथ पेंडीमेथिलिन 339 ग्रा./हे. के बाद पिनॉक्साडेन 50 ग्रा./हे. (प्रथम सिंचाई के बाद) का उपयोग करने पर अधिकतम सरसों के बीज एवं स्टोवर उपज प्राप्त की गई।

- ग्वालियर में, जैविक रूप से लगाए गए स्वीटकॉर्न – आलू– हरी खाद फसल प्रणाली में मृदा सूर्यीकरण के बाद 40 दिन पर हाथ से निदाई करने पर खरपतवारों के घनत्व में कमी के साथ अधिकतम आलू के कंद, शुद्ध लाभ एवं लाभ लागत अनुपात प्राप्त हुआ। स्वीटकॉर्न की फसल में 20 दिनों पर एक निदाई हाथ से करने के पश्चात 25 दिन पर घास की पुआल (5 टन/हे.) का उपयोग करने से अधिकतम भुट्टे की उपज के साथ शुद्ध लाभ एवं लाभ लागत अनुपात प्राप्त हुआ।

- आनंद (गुजरात) में, जैविक रूप से उगाये गये सौंफ – स्वीटकॉर्न फसल प्रणाली के अंतर्गत सौंफ की फसल में मृदा सूर्यीकरण के बाद हाथ से निदाई और 20 दिन पर घास की पुआल से मल्च (5 टन/हे.) तथा 50 दिन के बाद हाथ से निदाई अथवा 75 दिन के बाद मृदा सूर्यीकरण और स्वीटकार्न की फसल में बुवाई के समय प्लास्टिक मल्च के बाद 50 एवं 75 दिन पर हाथ से निंदाई करने पर प्रभावकारी खरपतवार प्रबंधन एवं अधिकतम उपज प्राप्त की गई।

- तेलंगाना में, 30 और 60 दिन पर रबी मक्का में खरपतवार का सूखा बजन शून्य जुताई तथा शून्य जुताई के साथ फसल अवशेष की तुलना में परंपरागत जुताई में काफी कम था। शून्य जुताई एवं शून्य जुताई + फसल अवशेष के अंतर्गत अंकुरण से पूर्व एट्राजीन 1000 ग्रा./हे +पैराक्वाट (600 ग्रा./हे.) तथा अंकुरण से 20–25 दिन बाद टेम्बोट्रिओन 120 ग्रा./हे प्रयोग की तुलना में परंपरागत जुताई में अंकुरण से पूर्व एट्राजीन (1000 ग्रा./हे.) तथा अंकुरण से 20–25 दिन बाद टेम्बोट्रिओन 120 ग्रा./हे. का उपयोग करने पर खरपतवार वृद्धि में कमी तथा मक्के की उपज में वृद्धि हुई।

maximum control of weeds and produced maximum seed and stover yield of chickpea.

- At Udaipur, in maize-chickpea cropping system, maximum seed yield (1.9 kg/ha) of chickpea was recorded with topramezone 25.2 g / ha as PoE (20 DAS) and EPoE (15 DAS).

- Under conservation tillage system, in maize-based cropping system, ZT+R suppressed the weeds with the application of pendimethalin 339 g / ha *fb* pinoxaden 50 g/ha (after first irrigation) and produced maximum seed and stover yield of mustard at Gwalior.

- At Gwalior, under organically grown sweetcorn- potato-green manure cropping system, soil solarization *fb* one HW at 40 DAS suppressed the weeds and produced the maximum tuber yield of potato with higher net return and B: C. In sweet corn maximum cob yield with higher net income and B:C was obtained with one HW at 20 DAS *fb* straw mulch (5 t/ha) at 25 DAS. It also gave better response to suppress the narrow and BLWs.

- At Anand, soil solarization *fb* HW and straw mulch 5 t/ha at 20 DAS *fb* HW at 50 and 75 DAS or soil solarization *fb* plastic mulch at sowing *fb* HW at 50 and 75 DAS found effective in controlling weeds and gave higher yield of fennel under organically grown fennel- sweetcorn cropping system.

- At Telangana, weed dry weight in *Rabi* maize was significantly lower in CT compared to ZT and ZT+R plots at 30 and 60 DAS. Application of atrazine 1000 g/ha + paraquat 600 g/ha PE *fb* tembotrione 120 g/ha at 20-25 DAS as PoE in ZT, ZT + R and atrazine 1000g / ha PE *fb* tembotrione 120 g/ha at 20-25 DAS as PoE in CT found to reduce the weed growth and enhance the maize yield in conservation agriculture (CA).

- हिसार में, संरक्षित कृषि के अंतर्गत मक्का आधारित फसल प्रणाली में 60 दिन पर, मक्के की फसल में एट्राजीन 1000 ग्रा./हे. (बुवाई के 10–15 दिन बाद) के बाद टोपरामेजोन 25.2 ग्रा./हे . या पाइरोक्सासल्फोन 127.5 ग्रा./हे. (अंकुरण से पूर्व) के बाद टेम्बोट्रिओन 120 ग्रा/हे. (अंकुरण के 20 से 25 दिन बाद) उपयोग करने पर अधिकतम खरपतवार नियंत्रण क्षमता पाई गई।

- भुवनेश्वर में, परंपरागत जुताई के साथ फसल अवशेष के अंतर्गत धान की सीधी बुवाई के 2 दिन बाद प्रीटिलाक्लोर + पाइराजोसल्फ्यूरॉन 615 ग्रा/हे. तथा बुवाई के 20 दिन पर साइहलोफोप + पेनोक्सुलम 135 ग्रा./हे. और 40 दिन के बाद हाथ से निदाई के बाद खरपतवार बीज कटाई करने पर अधिकतम खरपतवार नियंत्रण क्षमता पाई गई ।

- तेलंगाना में मक्के की फसल में अंकुरण के बाद एट्राजिन + मेसोट्रिओन 875 ग्रा./हे. का उपयोग करने पर बुवाई के 30 एवं 60 दिन बाद न्यूनतम खरपतवार घनत्व तथा अधिकतम उपज पाई गयी और यह 20 एवं 40 दिन पर हाथ से निदाई (5.7 टन/हे.) के बराबर थी।

- तेलंगाना में ज्वार की फसल में एट्राजिन 750 ग्रा./हे. के बाद 2 4–डी इथाइल एस्टर 500 ग्रा./हे.या एट्राजीन + टोप्रामेजोन 500 + 18.9 ग्रा./हे., का उपयोग करने पर क्रमशः 4.46 एवं 4.42 टन/हे. उपज प्राप्त हुई और यह खरपतवार मुक्त प्लॉट (4.91 टन/हे.) के बराबर थी। सबसे ज्यादा लाभ लागत अनुपात खरपतवार मुक्त प्लॉट (4.77) तथा एट्राजीन के बाद 2 4–डी एथिल एस्टर (4.56) तथा एट्राजिन+टोप्रामेजोन (4.31) में पाया गया ।

- बेंगलुरु में, रागी की फसल में, 20 एवं 40 दिन पर हाथ से निदाई ,फसल अवशेष मल्च (6 टन/हे.) के बाद 20 दिन पर हाथ से एक निदाई, स्टेल सीड बेड के 20 दिन बाद हाथ से एक निंदाई करने पर अधिकतम खरपतवार नियंत्रण पाया गया ।

- आनंद में, प्याज की नर्सरी में अंकुरण से पूर्व पेंडिमेथालिन 30 ई.सी. 300 (ग्रा./हे.) या अंकुरण के 10 दिन बाद प्रोपेक्विजाफोप 5% + ऑक्सीफ्लोरफेन 12% (43.75 + 105 ग्रा./हे.) का उपयोग करने से खरपतवारों पर अधिकतम नियंत्रण पाया गया ।

- केरल में, धान की फसल में साइहलोफोप ब्यूटाइल+पेनोक्सुलम

- At Hisar, in conservation weed management under maize based cropping system in maize, application of atrazine 1.0 kg/ha (EPOE) *fb* topramezone 25.2 g/ha and pyroxasulfone 127.5 g/ha (PE) *fb* tembotrione 120g/ha (20-25 DAS) resulted in significantly higher WCE compared to weedy at 60 DAS.

- CT+R in direct-seeded rice (DSR) with application of pretilachlor + pyrazosulfuron (RM) 615 g/ha at 2 DAS *fb* cyhalofop + penoxulam (RM) 135 g/ha at 20 DAS *fb* HW at 40 DAS *fb* weed seed harvest observed the superior treatment in managing weeds with maximum WCE (72%) at Bhubaneswar.

- Atrazine + mesotrione (RM) 875 g/ha as PoE (20 DAS) resulted in the significantly lower weed density and dry weight at both 30 and 60 DAS. The grain yield of maize was significantly higher and it was on par with two HW at 20 and 40 DAS (5.7 t/ha) at Telangana.

- At Telangana, significantly higher grain yield of sorghum was recorded in atrazine 750 g/ha *fb* 2 4-D ethyl ester 500 g/ha (4.46 t/ha) and atrazine + topramezone at 500+ 18.9 g/ha (4.42 t/ha) and both were at par with weed free plot (4.91 t/ha). Higher B:C was found with weed free plot (4.77) followed by atrazine *fb* 2,4-D ethyl ester (4.56) and atrazine + topramezone (4.31).

- At Bengaluru, in finger millet weed control 2 HW at 20 and 40 DAS followed by crop residue mulch 6 t/ha *fb* 1 HW 20 DAS and stale seedbed *fb* 1 HW 20 DAS were found best in controlling weeds.

- Pendimethalin 30 EC at 300 g/ha PE or propaquizafop 5% + oxyfluorfen 12% w/w EC (PM) at 43.75 + 105 g/ ha EPoE was found effective for management of complex weed flora in onion nursery at Anand.

- Application of cyhalofop butyl + penoxsulam at 150 g/ha

150 ग्रा./हे. का उपयोग करने पर *साल्विनिया मोलेस्टा* का असरदार नियंत्रण हुआ ।

- केरल में, प्रतिरोपीत धान में अंकुरण के पश्चात 30 दिन पर फेनॉक्साप्रोप– पी–इथाइल 120 ग्रा./हे. का प्रयोग किया गया जिससे ब्लड ग्रास का नियंत्रण बहुत प्रभावी ढंग से हुआ ।

- आनंद में, जैविक स्वीटकॉर्न की फसल में, मृदा सूर्यीकरण के बाद हाथ से निदाई + 20 दिन पर मल्च (5 टन/हे.) + 40 दिन पर हाथ से निदाई या मृदा सूर्यीकरण के बाद बुवाई के दौरान प्लास्टिक मल्च, के बाद 40 दिन पर हाथ से निदाई करने पर प्रभावी खरपतवार नियंत्रण एवं अधिकतम भुट्टे की उपज प्राप्त हुई ।

- रायपुर में, जैविक रूप से उगाए गए टमाटर में काली पॉलीथिन मल्च (20 माइक्रोन मोटाई) का उपयोग करने पर निम्नतम खरपतवार शुष्क भार, अधिकतम उत्पादन (36.5 टन/हे.) एवं शुद्ध लाभ (589302 रु/हे.) पाया गया। स्टेल सीड बेड एवं हाथ से तीन निदाई की तुलना में धान की पुआल और जलकुंभी की मल्च भी अधिकतम खरपतवार शुष्क भार कम करने में सक्षम है।

- भुवनेश्वर में, जैविक रूप से उगाये गए रागी फसल में, धान की पुआल मल्च (6 टन/हे.) के बाद 40 दिन पर हाथ से निंदाई करने पर अधिकतम खरपतवार नियंत्रण पाया गया ।

- आनंद गुजरात में, लूसर्न की फसल में अंकुरण के 10 दिन बाद पेंडीमेथालिन 30 ई.सी. 750 ग्रा./हे. या पेंडीमेथालिन 30%+ इमाजेथापायर 2% 800 ग्रा./हे. बुआई के 10 दिन बाद उपयोग करने पर *कस्कुटा* का प्रभावी नियंत्रण पाया गया।

- कोयंबतूर में, यूएएस–डी एएमएफ कॉन्सोर्टियम 8 कि.ग्रा./एकड़ का उपयोग करने पर निम्नतम *स्ट्राइगा* घनत्व (1/30 मी^{2}) जो की 3 दिन पर एट्राजिन 1000 ग्रा./हे. + 45 दिन पर हाथ से निंदाई + 60 दिन पर मिट्टी चढ़ाई+ अंकुरण के बाद 2 4–डी सोडियम साल्ट 5 ग्रा./ली. + 90 दिन पर यूरिया 20 ग्रा./ली. इसके बाद 120 दिन पर ट्रेस मल्चिंग 5 टन/हे. (1.25/30 मी^{2}) के बराबर जबकि बिना निंदाई वाले प्लॉट में सबसे ज्यादा *स्ट्राइगा* घनत्व (3/30 मी^{2}) पाया गया ।

- केरल में नारियल की फसल में आयुर्वेदिक इंडस्ट्रियल वेस्ट (औषधी वेस्ट) 20 टन/हे. का उपयोग करने पर 100% खरपतवार नियंत्रण पाया गया ।

was found effective in controlling *Salvinia molesta* in rice fields at Kerala.

- In Kerala, for managing blood grass (*Isachne miliacea*), PoE application of fenoxaprop-p-ethyl 120 g/ha at 30 days after transplanting was found most effective in transplanted rice.

- At Anand, soil solarization *fb* HW + straw mulch 5 t/ha at 20 DAS + HW at 40 DAS or soil solarization *fb* plastic mulch at sowing *fb* HW at 40 DAS found effective for weed control and gave higher green cob yield of sweet corn under organic cropping system.

- At Raipur, in organically grown tomato, lowest weed dry weight, highest yield (36.52 t/ha) and net returns (Rs. 589302/ha) were achieved under black polythene mulch (20 µ thickness). Paddy straw mulch and mulch with water hyacinth also reduced the weed dry weight as much as stale seed bed and 3 HW.

- At Bhubaneswar, rice straw mulch 6 t/ha *fb* 1 HW at 40 DAT was found to be the best weed management practice in controlling the complex weed flora in organically grown transplanted finger millet.

- Pendimethalin 30% EC 750 g/ha at 10 DAS or pendimethalin 30% + imazethapyr 2% EC (PM) 800 g/ha at 10 DAS was found effective for management of *Cuscuta* in lucerne at Anand.

- At Comibatore, application of UAS-D AMF Consortium at 8 kg/ac recorded lower *Striga* population (1.0 No./30 m2), which was on par with application of atrazine 1.0kg/ha at 3 DAP + HWat 45 DAP + earthing up at 60 DAP + PoE 2,4-D Na salt 5g/lit. + urea 20 g/lit. at 90 DAP *fb* trash mulching at 5 t/ha on 120 DAP (1.25 No./30 m^2). weedy check recorded higher *Striga* population (3.75 Nos/30 m^2) in sugarcane.

- In Kerala, application of ayurvedic industrial waste (Oushadi waste) 20 t / ha in the interspaces of coconut can give 100% weed control.

- गुंटूर में, उड़द की फसल में अंकुरण से पूर्व ड्रोन की सहायता से पेंडिमेथालिन 30%+ इमाजेथापायर 2% (1000 ग्रा./हे.) के बाद फोमेसेफेन 13.4%+ फ्लूजिफोप–पी–ब्यूटाइल 11.1% 220 ग्रा/हे. (बुआई के 20 दिन बाद) का उपयोग करने पर अधिकतम बीज उपज (1.02 टन/हे.) प्राप्त हुई । शाकनाशी की अनुसंशित मात्रा के शत–प्रतिशत उपयोग ड्रोन की सहायता करने से या उतनी ही मात्रा नेप सेक स्प्रेयर से करने पर (1.11 टन/हे.) बराबर खरपतवार नियंत्रण क्षमता एवं उपज दर्ज की गई ।

- पांडिचेरी के कोस्टल एरिया में सीधी शुष्क धान बुवाई में अंकुरण से पूर्व पेनॉक्सुलम+पेंडिमेथालिन 625 ग्रा./हे. के बाद फेनोक्साप्रोप एथिल 67 ग्रा./हे.+इथोक्सीसल्फ्यूरॉन 18 ग्रा./हे. (अंकुरण के बाद) का उपयोग करने पर निम्नतम खरपतवार घनत्व (5.2/मी^{2}) तथा अधिकतम बीज उपज (3.39 टन/हे.) प्राप्त हुई ।

- बांदा में, पेंडिमिथालिन 30 ईसी (पीई) 750 ग्राम/हेक्टेयर के बाद प्रोपाक्विजाफॉप 5+ऑक्सीफ्लूरेफेन 12 डब्ल्यू/डब्ल्यू ईसी रेडी–मिक्स बुवाई के पश्चात 43.75+105 ग्राम के उपयोग से खरपतवार घनत्व और सूखे वजन में काफी कमी आई जबकि अधिकतम खरपतवार नियंत्रण दक्षता, फसल सूचकांक और लाभ लागत अनुपात 2.0 से अधिक दर्ज किए गए।

- जोबनेर में, टैंक मिश्रण शाकनाशी पाइरोक्सासल्फोन + मेटसल्फ्यूरॉन (127.5+4) ग्राम/हेक्टेयर के उपयोग से अधिकतम अनाज और भूसे की उपज दर्ज की गई जबकि खरपतवारों की संख्या न्यूनतम पाई गई।

- कश्मीर में, मेटसल्फ्यूरॉन–मिथाइल 10+क्लोरीमुरॉन–एथिल 10 (4 ग्राम/हेक्टेयर) के प्रयोग से 81–84% डब्ल्यूसीई के साथ चावल में खरपतवार का प्रकोप और खरपतवार का सूखा वजन काफी कम हो गया।

- येरागट्टी गांव, बेलगावी जिला, धारवाड़ में यूएएसडी एएमएफ कंसोर्टियम के अनुप्रयोग के परिणामस्वरूप पौधों की ऊंचाई, टिलर की संख्या, सापेक्ष क्लोरोफिल मात्रा, डिहाइड्रोजनेज गतिविधि और फॉस्फेट गतिविधि में वृद्धि हुई, जबकि *स्ट्रिगा* उद्भव की संख्या कम हो गई।

- In blackgram at Guntur PE application of pendimethalin 30% + imazethapyr 2% (RM) at 1000 g/ha *fb* fomesafen 13.4% + fluazifop-p-butyl 11.1% (RM) at 220 g/ha with drone application at 20 DAS resulted in higher seed yield (1.02 t/ha). 100% RDH with drone application was comparable with application of same herbicides with knapsack sprayer (1.11 t/ha).

- Sequential application of penoxsulam + pendimethalin 625 g/ha as PE *fb* fenoxaprop ethyl 67 g/ha + ethoxysulfuron 18 g / ha as PoE (25-30 DAS) recorded lower total weed density (5.2 no./m^2), resulted in higher grain yield (3.39 t/ha) in dry-DSR in coastal deltaic region of Karaikal, Puducherry.

- At Banda, weed density and dry weight were significantly reduced with the use of pendimethalin 30 EC (PE) @ 750 g/ha *fb* propaquizafop 5 + oxyfluorfen 12 w/w EC RM PoE @ 43.75g + 105g, while maximum weed control efficiency, harvest index and B:C greater than 2.0 were recorded.

- At Jobner, application of tank mix herbicides pyroxasulfone + metsulfuron @ 127.5 + 4 g/ha recorded maximum grain and straw yield with minimum weeds count.

- At Kashmir, the application of metsulfuron-methyl 10+chlorimuron-ethyl 10 (4 g/ha) significantly reduced weed infestation and weed dry weight in rice with 81-84% WCE

- Application of the UASD AMF consortium at Yeragatti Village, Belagavi District, Dharwad resulted in an increase in plant height, the number of tillers, relative chlorophyll content, dehydrogenase activity, and phosphatase activity, while the number of *Striga* emergence was reduced.

डब्ल्यू पी 2. गैर फसली एवं जलीय क्षेत्रों में खरपतवार प्रबंधन

- बेंगलुरु में, पूरे पौधे का अर्क 120 ग्राम/पौधा *अल्टरनेथेरा फिलोक्सेरोइड्स* के एक्स यौगिक से जलकुंभी के विकास में भारी कमी देखी गयी जो जलकुंभी को नियंत्रित करने में जैविक एजेंट के रूप में *अल्टरनेथेरा फिलोक्सेरोइड्स* के उपयोग की क्षमता को दर्शाता है।

- *साइरटोबैगस साल्विनिया* ने महाराष्ट्र के अकोला के गढ़चिरौली (हेती, लांजेडा और इंद्र नगर झील) और चंद्रपुर जिलों (जूनोना और घोड़पेठ झील) की झीलों में *साल्विनिया मोलेस्टा* को सफलतापूर्वक नियंत्रित किया।

- जोरहाट में, ग्लाइफोसेट 71% पूर्व मिश्रित अमोनियम सल्फेट और ग्लाइफोसेट 41%+ अमोनियम सल्फेट का दो महीने के अंतराल पर दो बार उपयोग करने से गैर–फसली स्थिति में *पैनिकम रिपेंस* का 91.94% और 91.04% नियंत्रण हुआ, जिससे लगभग 90.7% और 88.9% भूमिगत खरपतवार प्रकंदो की क्षति हुई।

- पालमपुर में, अगस्त के महीने में *लेंटाना केमारा* की झाड़ियों की कटाई से शूट की ऊंचाई काफी कम हो गई और सभी चरणों में *लैंटाना कैमारा* का शुष्क पदार्थ कम हो गया। कटिंग के एक महीने के बाद स्प्रे से *एल. कैमारा* की शूट ऊंचाई अवलोकन के सभी चरणों में काफी कम थी। शाकनाशी अनुप्रयोग के बीच, ग्लाइफोसेट + एमएसएम + सर्फेक्टेंट के परिणामस्वरूप *एल. कैमारा* के पौधे बिना छिड़काव वाले नियंत्रण की तुलना में छोटे हो गए।

- त्रिशूर में, यह पाया गया कि *लिम्नोफिला, कैबोम्बा* और *हाइड्रिला* जैसे जलीय खरपतवार अम्लीय पीएच पसंद करते हैं। चूना लगाने से पानी का पीएच तेजी से बढ़ता है और चूना लगाने के 4 दिनों के भीतर 90% से अधिक नियंत्रण मिल सकता है। इसका परीक्षण किसानों के खेतों में भी किया गया। यह तकनीक अत्यधिक उपयोगी और व्यावहारिक अनुप्रयोग वाली है क्योंकि हाल ही में मीठे पानी के तालाबों में जलीय खरपतवार एक उभरती हुई समस्या रही है। जिप्सम का उपयोग

WP2. Management of weeds in non-cropped and aquatic areas

- At Bengaluru, the whole plant extract @ 120g/plant + X compound of *Alternanthera philoxeroides* showed a drastic reduction in the growth of water hyacinth indicating the potential of *Alternanthera philoxeroides* to be used as biological agent in controlling water hyacinth.

- *Cyrtobagous salviniae* successfully controlled the *Salvinia molesta* in lakes of Gadchiroli (Heti, Lanjeda and Indra nagar lake) and Chandrapur districts (Junona and Ghodpeth lake) of Maharashtra.

- Application of glyphosate 71% premixed amonium sulphate and glyphosate 41% + Ammonium sulphate twice at an interval of two month resulted in 91.94% and 91.04% control of *Panicum repens* in non-cropped situation, damaging nearly 90.7% and 88.9% underground rhizome of the weed, respectively In Jorhat.

- At Palampur, cutting of bushes in the month of August significantly reduced the shoot height and dry matter accumulation of *Lantana camara* at all the stages spray after cutting was significantly less at all the stages of observation. Among the herbicide application, glyphosate + MSM + surfactant resulted in smaller plants of *L. camara* than unsprayed control.

- At Thrissur, it was found that the aquatic weeds like *Limnophila, Cabomba,* and *Hydrilla* prefers, acidic pH. lime application as quick increase the pH of water can give more than 90% control within 4 days of liming. This was field tested in farmers' fields also. This technology is highly useful and of practical application as recently aquatic weeds have been an emerging problem in freshwater ponds. The use of gypsum was found to

साल्विनिया मोलेस्टा की वृद्धि को बढ़ाने के लिए पाया गया और इस संशोधन का उपयोग वहां नहीं किया जाना चाहिए जहां *साल्विनिया मोलेस्टा* एक समस्या है।

- त्रिशूर में, जिन शाकनाशीयों का परीक्षण किया गया, उनमें 2 4–डी सोडियम नमक (1000 ग्रा./हेक्टेयर), फ्लोरपाइरॉक्सिफेन–बेंजिल (31.5 ग्राम/हेक्टेयर) और साथ ही फ्लोरपाइरॉक्सिफेन–बेंजिल + साइहलोफॉप ब्यूटाइल (150 ग्रा/हेक्टेयर) का एक पूर्व–मिश्रण संयोजन शामिल है। छिड़काव के 20 दिन बाद 98–100% डब्ल्यूसीई दर्ज की गयी।

डब्ल्यू पी 3 विभिन्न कृषि–पारिस्थितिकी प्रणालियों में शाकनाशी अवशेषों की स्थिति

- लुधियाना में चावल–सरसों की फसल प्रणाली में, सरसों में सी. टी. और जेड.टी. + आर उपचार के तहत मिट्टी में पायरोक्सासल्फोन का आधा जीवन क्रमशः 11.38 से 19.39 और 8.88 से 15.68 दिनों तक भिन्न होता है, जबकि पेंडिमिथालिन के लिए डीटी$_{50}$ 20.21 से 35.83 और 17.43 से 27.79 दिनों तक भिन्न होता है।

- मटर में, अलग–अलग उपचारों में मिट्टी में पेंडीमेथालिन और मेट्रिब्यूजिन का आधा जीवन क्रमशः 17.43 से 22.77 और 8.89 से 25.56 दिनों तक था, जबकि क्लोडिनाफॉप के अवशेष लुधियाना में अनुप्रयोग के 3 दिन बाद पता लगाने योग्य सीमा से नीचे थे।

- पंजाब के विभिन्न जिलों में किसानों के खेतों से कटाई के समय एकत्र किए गए गेहूं के नमूनों में क्लोडिनाफॉप, सल्फोसल्फ्यूरॉन, मेटसल्फ्यूरॉन, पिनोक्साडेन, पेंडिमिथालिन, मेट्रिब्यूजिन, पाइरोक्ससल्फोन, मेसोसल्फ्यूरॉन मिथाइल और आयोडोसल्फ्यूरॉन मिथाइल के अवशेष लुधियाना में पता लगाने योग्य सीमा (0.01 माइक्रोग्राम/ग्राम) से कम थे।

- कोयंबटूर में बेबीकॉर्न में, विभिन्न भूखंडों की मिट्टी और बेबी कॉर्न कोब में 2 4–डी, टेम्बोट्रियोन, टोप्रामेजोन और एट्राजिन के अवशेष जुताई और खरपतवार प्रबंधन प्रथाओं में 0.01

enhance the growth of *S. molesta* and this amendment should not be used where *S. molesta* is a problem.

- At Thrissur, among the herbicides tried, 2,4-D sodium salt (1000 g/ha), florpyrauxifen-benzyl (31.5 g/ha) as well a pre-mix combination of florpyrauxifen-benzyl + cyhalofop butyl (150 g/ha), were effective with 98-100% WCE recorded at 20 days after spraying.

WP3 Fate of herbicide Residues in different agro-ecosystems

- In rice-mustard system, in mustard, half-life of pyroxasulfone in soil under CT and ZT+R treatments varied from 11.38 to 19.39 and 8.88 to 15.68 days, respectively while for pendimethalin, DT_{50} varied from 20.21 to 35.83 and 17.43 to 27.79 days, respectively of Ludhiana.

- At Ludhiana, in pea, half-life of pendimethalin and metribuzin in soil varied from 17.43 to 22.77 and 8.89 to 25.56 days, respectively in different treatments, while residues of clodinafop were below detectable limit 3 days after application.

- The residues of clodinafop, sulfosulfuron, metsulfuron, pinoxaden, pendimethalin, metribuzin, pyroxasulfone, mesosulfuron methyl and iodosulfuron methyl in wheat samples collected at harvest from farmer's fields in different districts of Punjab were below detectable limits (<0.01 µg/g).

- In babycorn, the residues of 2,4-D, tembotrione, topramezone and atrazine in soil and baby corn cob from different plots were below 0.01 mg/kg irrespective of the tillage and weed management practices. Whereas,

मिलीग्राम/किलोग्राम से कम थे। जबकि, मिट्टी में फसल कटाई के समय 1.0 किग्रा/हेक्टेयर एट्राजिन के उपयोग से 0.023 से 0.038 मिलीग्राम/किलोग्राम अवशेष दर्ज किए गए।

- हैदराबाद में, मिट्टी में टॉपरेमेजोन अवशेषों का आकलन शाकनाशी के प्रयोग के 60 दिन बाद और फसल की कटाई के समय तक किया जा सकता है। मिट्टी में टोप्रामेजोन के प्रारंभिक अवशेष 0.013 से 0.019 थे और मिट्टी में टेम्बोट्रियोन अवशेष 0. 026 से 0.037 तक थे। कटाई के समय, मिट्टी, अनाज और पौधे में टेम्बोट्रियोन और टोप्रामेजोन अवशेष पता लगाने की सीमा (0.01 माइक्रोग्राम/ग्राम) से नीचे थे।

- हैदराबाद में, शाकनाशी अनुप्रयोग के 4 घंटे बाद क्विजालोफॉप के प्रारंभिक अवशेष मिट्टी के नमूनों में 0.040 से 0.053 माइक्रोग्राम/ग्राम पाए गये। शाकनाशी के प्रयोग के 15 दिन बाद तक मिट्टी में क्विजालोफॉप की मौजूदगी देखी जा सकती है। कटाई के समय अंतिम मिट्टी के नमूनों में पेंडीमेथालिन अवशेष 0.010 माइक्रोग्राम/ग्राम की पहचान सीमा से नीचे थे।

application of atrazine at 1.0 kg/ha recorded residues of 0.023 to 0.038 mg/kg at harvest in soil at Coimbatore.

- At Hyderabad, topramezone residues in soil could be assessed in soil at 60 days after application of the herbicide and at harvest stage of the crop. The initial residues of the topramezone in soil was 0.013 to 0.019 µg/g and tembotrione residues in soil varied from 0.026 to 0.037 µg/g. At the time of harvest, the tembotrione and topramezone residues in soil, grain and plant were below the detection limits (0.01 µg/g).

- Initial residues of quizalofop at 4 hours after herbicide application varied from 0.040 to 0.053 µg/g in the soil samples. Persistence of quizalofop in soil could be noticed up to 15 days after herbicide application. In the final soil sample at the time of harvest, the pendimethalin residues were below the detection limit of 0.010 µg/g in all the soil samples of Hyderabad.

डब्ल्यू पी 4 खरपतवार प्रबंधन प्रौद्योगिकियों का प्रदर्शन और प्रभाव मूल्यांकन

- पंतनगर के भाबर क्षेत्र में सोयाबीन के खेत पर किए गए अनुसंधान परीक्षणों में, सोडियम एसिफ्लोरफेन + क्लोडिनाफॉप प्रोपरगिल 165 . 80 ग्राम/हेक्टेयर (बुवाई के पश्चात) के तैयार–मिश्रण के अनुप्रयोग में सबसे कम कुल खरपतवार घनत्व, सूखा वजन और उच्च डब्ल्यूसीई (80.2%) पाया गया जो किसानो प्रथाओं की तुलना में अधिक दर्ज की गयी।
- पंतनगर में, तराई क्षेत्र में मक्का पर कृषि अनुसंधान के तहत, एट्राजिन 500 ग्राम/हेक्टेयर+टोप्रामेजोन 25.2 ग्राम/हेक्टेयर (बुवाई के पश्चात) के टैंक–मिश्रण अनुप्रयोग में सबसे कम कुल खरपतवार घनत्व, सूखा वजन और उच्चतम डब्ल्यूसीई (79.9%) दर्ज किया गया। जो किसान के अभ्यास की तुलना में डब्ल्यूसीई (76.6%) अधिक दर्ज की गयी ।
- पंतनगर, तराई क्षेत्र में कृषि अनुसंधान के तहत, गन्ने की फसल में 875 ग्राम/हेक्टेयर (बुवाई से पूर्व) पर मेसोट्रियोन 2.27%+ एट्राजिन 22.7% एससी का तैयार–मिश्रण के अनुप्रयोग, किसान

WP 4 Demonstration and Impact assessment of weed management technologies

- In soybean OFR conducted in Bhabar area in Pantnagar, ready-mix application of sodium acifluorfen + clodinafop propargyl 165 + 80 g/ha (PoE) recorded lowest total weed density, dry weight and higher WCE (80.2 %) over farmer practice (74.8 %).
- At Pantnagar, in maize under OFR, tank-mix application of atrazine 500 g/ha + topramezone 25.2 g/ha (PoE) recorded lowest total weed density, dry weight and highest WCE (79.9 %) over farmer's practice (76.6 %).
- At Pantnagar, Tarai area under on farm research, ready-mix application of mesotrione 2.27% + atrazine 22.7% SC at 875 g/ha (PE) recorded lowest total weed density, dry weight and highest WCE (75.6 %) over farmer's

के अभ्यास की तुलना में सबसे कम कुल खरपतवार घनत्व, सूखा वजन और उच्चतम डब्ल्यूसीई (75.6%) दर्ज किया गया।

- आनंद में, मक्का पर ओएफआर का प्रदर्शन किया गया, एट्राजिन 50% डब्ल्यूपी+टोप्रामेजोन 336 ग्राम/लीटर डब्ल्यू/वी एससी (टीएम) 500+25.2 ग्राम/हेक्टेयर बुवाई के पश्चात (15–20 डीएएस) किसानों के अभ्यास (आईसी+एचडब्ल्यू) के समान ही प्रभावी पाया गया।
- आनंद में ऑन फॉर्म रिसर्च ट्रायल के तहत सोयाबीन में , किसानों के प्रथाओं (20 और 40 डीएएस पर आईसी+एचडब्ल्यू) की तुलना में खरपतवार प्रबंधन के लिए 40 डीएएस पर प्रोपाक्विजाफॉप+इमाजेथापायर के बाद आईसी+एचडब्ल्यू को प्रभावी पाया गया।
- अकोला में, बुलढाणा जिले के मसरुल और जामथी में रबी 2022 के दौरान मक्के पर किए गए ऑन फार्म रिसर्च परीक्षणों से पता चला कि एट्राजिन 80% डब्ल्यूपी के बाद टोप्रामेजोन 25.29 ग्राम/हेक्टेयर (336 ग्राम/लीटर डब्ल्यू) से अधिकतम उपज 715 टन/हेक्टेयर दर्ज की गयी है।
- त्रिशूर में, चावल में खरपतवार *लिम्नोचारिस फ्लेवा* के शाकनाशी नियंत्रण की प्रभावकारिता का परीक्षण करने के लिए चार स्थानों पर ऑन–फार्म अनुसंधान किया गया था, जो हाल ही में कई किसानों द्वारा बताई गई एक समस्या है। इस खरपतवार के प्रबंधन की तकनीक विकसित की गई। यह पाया गया कि उभरने के बाद (चावल बोने के 18–20 दिन बाद) 2 4–डी सोडियम नमक / 1 किग्रा/हेक्टेयर या पेनोक्ससुलम + पेंडिमिथालिन / 625 ग्राम/हेक्टेयर के साथ एक सहायक स्टीकर / 2 मिली/लीटर स्प्रे तरल पदार्थ से खरपतवार को प्रभावी ढंग से नियंत्रित किया जा सकता है। बुआई के 45 दिन बाद 100% खरपतवार नियंत्रण दक्षता हासिल की जा सकती है।
- टमाटर और बैंगन में *ओरोबैंके* के प्रबंधन के लिए उदयपुर द्वारा आयोजित फार्म रिसर्च परीक्षणों में ये पता चला की, 25 डीएटी के बाद पर 25 ग्राम/हेक्टेयर एथोक्सी सल्फ्यूरॉन का 50 डीएटी पर 50 ग्राम/हेक्टेयर का उपयोग संक्रमण को कम करने और बैंगन और टमाटर की उपज बढ़ाने में प्रभावी था।
- लुधियाना द्वारा आयोजित फ्रंट लाइन प्रदर्शन, गांव मंसूरान जिला 2016 से पार्थेनियम मुक्त गांव बना हुआ है। पीएयू के एआईसीआरपी–डब्ल्यूएम कर्मचारियों के सहयोग से, ग्रामीणों द्वारा इसका रखरखाव किया जाता है।
- कोयंबटूर में, प्याज पर फ्रंट लाइन प्रदर्शन से पता चला कि ऑक्सीफ्लोरफेन 0.25 किग्रा/हेक्टेयर + (30–35 डीएपी पर हाथ से निराई) करने से व्यापक स्पेक्ट्रम खरपतवार नियंत्रण, उच्च बीज उपज और प्याज में आर्थिक रिटर्न दर्ज किया गया।

practice (54.6%) in sugarcane.

- At Anand, OFR were demonstrated atrazine 50% WP + topramezone 336 g/l w/v SC (TM) at 500 + 25.2 g/ha PoE (15-20 DAS) found equally effective as farmers practice (IC+HW at 20 and 40 DAS) in *Rabi* maize.
- In soybean under On Form Research Trial, propaquizafop + imazethapyr *fb* IC + HW at 40 DAS was found effective for weed management than farmers practice (IC + HW at 20 & 40 DAS), at Anand.
- At Akola, OFR conducted on maize during *Rabi* 2022 at Masrul and Jamthi of Buldhana district revealed maximum yield of 7.15 t/ha in the plot applied with atrazine 80% WP *fb* topramezone 25.29 g/ha (336 g/l w/v SC).
- At Thrissur, OFR was done at four locations to test the efficacy of herbicidal control of the weed *Limnocharis flava* in rice, which is a problem weed reported recently by many farmers. The technology for the management of this weed was developed. It was found that post-emergent application (18-20 days after sowing rice) of 2,4-D sodium salt @ 1 kg/ha or penoxsulam + pendimethalin @ 625 g/ha along with an adjuvant/ sticker @ 2 ml/L of spray fluid can effectively control the weed. At 45 days after sowing, 100% weed control efficiency could be realized.
- On Farm Research trials conducted by Udaipur, for management of *Orobanchae* in tomato and brinjal, application of ethoxy sulfuron 25 g/ha at 25 DAT *fb* 50 g/ha at 50 DAT was effective reducing infestation and increasing brinjal and tomato yield.
- Front Line Demonstration conducted by Ludhiana, Village Mansuran district o continued to be Parthenium free village since 2016. maintained by villagers, with collaboration of AICRP-WM staff from PAU.
- At Coimbatore, FLDs on onion revealed that application of PE oxyfluorfen 0.25 kg/ha + hand weeding on 30-35 DAP recorded broad spectrum weed control, higher seed yield and economic returns in onion.

- त्रिशूर में, खरपतवार प्रबंधन में एससीएसपी कार्यक्रम के तहत एफएलडी को लिया गया था। लाभार्थियों को शाकनाशी, स्प्रेयर के साथ–साथ ब्रश कटर भी दिए गए और प्रशिक्षण कार्यक्रम आयोजित किए गए।
- जम्मू में, एससीएसपी कार्यक्रम के तहत गेहूं में खरपतवार प्रबंधन पर तीन अलग–अलग स्थानों पर पचास फ्रंट लाइन प्रदर्शन आयोजित किए गए और पाया गया कि नए शाकनाशीयानी क्लोडिनाफॉप–प्रोपरगिल+मेटसल्फ्यूरॉन 60+4 ग्राम/हेक्टेयर के प्रयोग से 3.33 3.23%, 3.02%, 3.19% और 3.51% औसत उपज दर्ज की गयी जो किसान की प्रथा मेट्रिव्यूजिन 200 ग्राम/हे. 30–35 दिन बाद की तुलना में अधिक थी।
- एससीएसपी कार्यक्रम के तहत प्रत्यारोपित चावल में खरपतवार प्रबंधन पर जम्मू द्वारा आयोजित फ्रंट लाइन प्रदर्शन, 25 डीएटी पर नई शाकनाशी ट्रायफामोन+एथोक्सीसल्फ्यूरॉन 66.5 ग्राम/हेक्टेयर ने किसान के प्रथा की तुलना में 11.01% अधिक औसत उपज दर्ज की गयी।

- At Thrissur, FLDs were taken up under the SCSP programme in weed management in rice. Beneficiaries were given inputs, herbicides, sprayers as well as brush cutters and training programmes were organized.
- At Jammu, fifty FLDs in three different locations on weed management in wheat under SCSP programme conducted and found that the new herbicidal interventions *i.e* clodinafop-propargyl + metsulfuron 60 + 4 g/ha at 30-35 DAS recorded 3.33, 3.23%, 3.02%, 3.19% and 3.51% higher mean yield at three locations, respectively as compared to farmer's practice metribuzin 200 g/ha at 30-35 DAS.
- FLDs conducted by jammu on weed management in transplanted rice under SCSP programme, the new herbicidal innervation *i.e.* triafamone + ethoxysulfuron 66.5 g/ha at 25 DAT recorded 11.01% higher mean yield as compared to farmer's practice (bispyribac-sodium 25g/ha at 25 DAT).

1 ORGANIZATION AND FUNCTIONING

1.1 Introduction

The All India Coordinated Research Project on Weed Management was launched in April,1978 by the ICAR in collaboration with the United States Department of Agriculture (USDA) at six locations, Punjab Agricultural University, Ludhiana (Punjab); University of Agricultural Sciences, Bengaluru (Karnataka); Indian Institute of Technology, Kharagpur (West Bengal); Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.); Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (U.P.); and Himachal Pradesh Krishi Vishwa Vidyalaya, Palampur (H.P.). The initial financial outlay of Rs. 42.97 lakhs for five years. The tenure of the project was, however, extended for one more year till March, 1984 with the savings. Further work was continued at these centres with the AP Cess fund of ICAR till the implementation of VII Plan in April, 1986.

The activities of the project were extended covering 7 more cooperating centres, Assam Agricultural University, Jorhat (Assam); Marathwada Agricultural University, Parbhani (Maharashtra); Gujarat Agricultural University, Anand (Gujarat); Narendra Dev University of Agriculture and Technology, Faizabad (U.P.); Indian Institute of Horticultural Research, Bengaluru (Karnataka); Indian Grassland and Fodder Research Institute, Jhansi (U.P.) and Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu) through a fresh negotiation between ICAR and FERRO, USDA with a sanctioned outlay of Rs 58.10 lakhs for five years. The work at these centres was effectively implemented from 1982-83 to 1986-87.

In the third phase, 9 more centres, Birsa Agricultural University, Ranchi (Bihar); Haryana Agricultural University, Hisar (Haryana); Vishwa Bharati, Sriniketan (W.B.); Rajendra Agricultural University, Pusa (Bihar); Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.); Kerala Agricultural University, Thrissur (Kerala); Orissa University of Agriculture and Technology, Bhubaneswar (Orissa); Acharya N.G. Ranga Agricultural University, Hyderabad (Andhra Pradesh) and ICAR Research Complex, Barapani (Meghalaya) were initiated at total outlay of Rs. 63.85 lakhs for four years (1985-86 to 1989-90) with the assistance of USDA under USIF funds. In the VIII Plan, 4 new centres, Rajasthan Agricultural University, Bikaner; Indira Gandhi Krishi Vishva Vidyalaya, Raipur; Konkan Krishi Vidhya Peeth, Dapoli and University of Agricultural Sciences, Dharwad were initiated with total outlay of 16.41 lakhs. Seventy five percent of the total budget required by each centre was provided by the ICAR and the remaining 25% was met from the state department of agriculture as a state share. There was however, 100% funding by the ICAR to Visva Bharati, Sriniketan.

During IX Plan (1997-2002), X Plan (2002-2007), XI plan (2007-2012) and XII plan (2012-17) the total expenditure incurred under AICRP-WM was Rs. 823.79, 1696.57, 3548.78 lakhs and 4007.26 lakhs, respectively. During XII Plan (2012-17), four AICRP on Weed Management centres, University of Agricultural Sciences, Dharwad; Chandra Shekhar Azad University of Agriculture & Technology, Kanpur; Swami Keshwanand Rajasthan Agricultural University, Bikaner, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani and Visva-Bharati, Sriniketan were closed and new centers at Maharana Pratap University of Agriculture and Technology, Udaipur; University of Agricultural Sciences, Raichur; Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola; Bidhan Chandra Krishi Viswavidyalaya, Kalyani; Sher-eKashmir University of Agricultural Sciences and Technology, Jammu and Central Agricultural University, Pasighat by redeployment of existing manpower were opened. As per the approval of SFC (2017-20), another six coordinating centres (NDUAT, Faizabad; CAU, Pasighat; RAU, Pusa; BAU, Ranchi; DBSKKV, Dapoli and UAS, Raichur) were closed *w.e.f.* 1.4.2018.

The coordinating unit of the project was located initially at Central Rice Research Institute, Cuttack, and shifted to National Research Centre for Weed Science in 1989. Later in 2009, NRC for Weed Science was

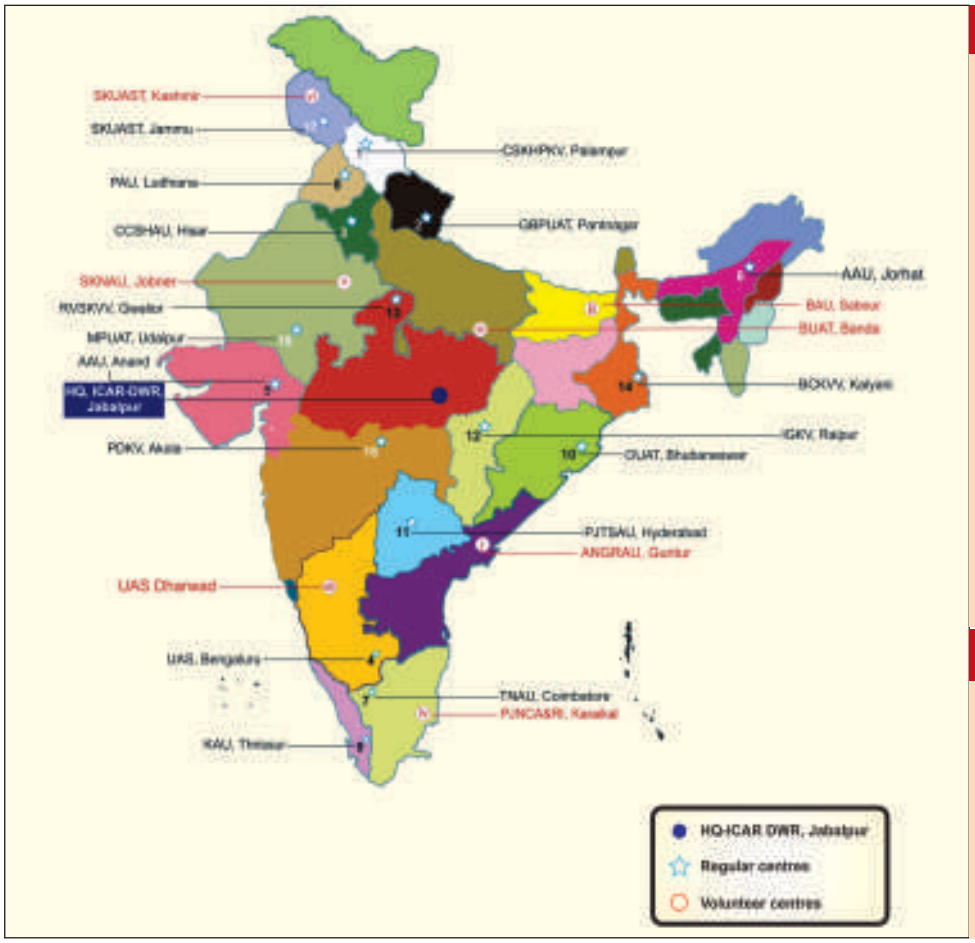
upgraded to Directorate of Weed Science Research. During XII Plan (2012-17), it has renamed as "Directorate of Weed Research" and "AICRP on Weed Control" was renamed as "AICRP on Weed Management"

1.2 Mandate

- To conduct location-specific research for developing appropriate weeds management technologies.
- To demonstrate the weed management technologies through on-farm adaptive trials.

1.3 Objectives

- To work out effective and economic weed management modules for field and horticultural crops, in non-crop and aquatic situations
- To Study long-term residual and cumulative effect of herbicide, if any.
- To evaluate new herbicides and working out the residual effect on non-targeted organisms
- To study biology and control of problem weeds including aquatic and parasitic weeds
- To analyze herbicide residues in soil, water and food chain.
- To test available tools/ implements for weed management under various agro-ecosystems
- To transfer weed management techno-logies on farmers' fields through OFT and FLDs their impact assessment and training.



AICRP-WM Regular Centres	
01	CSKHPKV, Palampur
02	GBPUAT, Pantnagar
03	CCSHAU, Hisar
04	UAS, Bengaluru
05	AAU, Anand
06	AAU, Jorhat
07	TNAU, Coimbatore
08	PAU, Ludhiana
09	KAU, Thrissur
10	OUAT, Bhubaneswar
11	PJTSAU, Hyderabad
12	IGKV, Raipur
13	RVSKVV, Gwalior
14	BCKVV, Kalyani
15	MPUAT, Udaipur
16	PDKV, Akola
17	SKUAST, Jammu

Volunteer Centres	
i	ANGRAU, Guntur
ii	BAU, Sabour
iii	BUAT, Banda
iv	PJNCA&RI, Karaikal
v	SKNAU, Jobner
vi	SKUAST, Kashmir
vii	UAS, Dharwad

2 STAFF POSITION AND EXPENDITURE

AICRP on Weed Management is presently under operation in 17 State Agricultural Universities in 17 different states of the country and represent diverse agro-ecological regions. Altogether, 34 scientists of Agronomy, Residue Chemistry and Taxonomy are working in inter-disciplinary mode. Besides 17 main centres, 7 volunteer centres are also in operation. The details of staff position and funds allocated in the financial year 2023-24 are given below:

Staff position at different coordinating centres during 2023-24

Centre	Scientific		Technical		Driver	
	Sanctioned	Filled	Sanctioned	Filled	Sanctioned	Filled
PAU, Ludhiana	2	2	1	1	-	-
UAS, Bengaluru	2	2	1	1	1	1
RVSKVV, Gwalior	2	2	1	1	-	-
GBPUAT, Pantnagar	2	2	1	1	-	-
CSKHPKV, Palampur	2	1	1	1	1	1
AAU, Jorhat	2	2	1	1	1	1
AAU, Anand	2	2	1	1	1	1
TNAU, Coimbatore	2	2	1	1	1	1
KAU, Thrissur	2	2	1	-	1	-
OUAT, Bhubaneshwar	2	2	1	1	1	1
PJTSAU, Hyderabad	2	2	1	-	1	-
CCSHAU, Hisar	2	2	1	-	-	-
IGKVV, Raipur	2	2	1	1	-	-
PDKV, Akola	2	1	1	1	-	-
MPUAT, Udaipur	2	1	1	-	-	-
SKUAST, Jammu	2	2	1	1	-	-
BCKV, Kalyani	2	2	1	-	-	-
Total	**34**	**31**	**17**	**12**	**08**	**06**

Funds released to different coordinating centres during the financial year 2023-24

(Rs. in lakh)

Sl. No.	Centre Name	ICAR Share
1	PAU, Ludhiana	63.80
2	UAS, Bengaluru	60.63
3	RVSKVV, Gwalior	86.08
4	GBPUAT, Pantnagar	69.73
5	CSKHPKV, Palampur	79.24
6	AAU, Jorhat	85.05
7	AAU, Anand	44.96
8	TNAU, Coimbatore	57.48
9	KAU, Thrissur	38.43
10	OUAT, Bhubaneshwar	50.37
11	PJTSAU, Hyderabad	90.08
12	CCSHAU, Hisar	31.54
13	IGKV, Raipur	51.26
14	PDKV, Akola	22.89
15	BCKV, Kalyani	38.04
16	MPUAT, Udaipur	55.02
17	SKUAST, Jammu	54.51
18	PC Unit, Jabalpur	4.68
	Total	**983.79**

3 RESEARCH ACHIEVEMENTS

WP-1 Development of location-specific sustainable weed management practices

WP-1.1 Weed management in major crops and cropping systems

WP-1.1.1. Weed management in *tar-vattar* direct-seeded rice (DSR)

Network centres: CCSHAU Hisar, GBPUAT Pantnagar, SKUAST Jammu

Treatments:

Main plot: Timing of first irrigation

IR 2 -14 days after sowing

IR 3 -21 days after sowing

Sub-plot: Weed management

WM 1-Pendimethalin + pyrazosulfuron-ethyl (RM) 785 g/ha as PE *fb* 1 HW at 30 DAS

WM 2-Penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* bispyribac–sodium 25 g/ha as PoE (25-30 DAS)

WM 3-Penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* fenoxaprop ethyl 67g/ha + ethoxysulfuron 18 g/ha as PoE (25-30 DAS)

WM 4-Pendimethalin 678 g/ha (38.7 CS) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron methyl + chlorimuron ethyl) (RM)] 4 g/ha (TM) as PoE (25-30 DAS)

WM 5-Pendimethalin 678 g/ha (38.7 CS) as PE *fb* penoxsulam + cyhalofop-butyl (RM) 135 g/ha as PoE (25-30 DAS)

WM 6-3 HW at 20, 30 and 60 DAS

WM 7- Partially weedy check (Weeds will be removed at 60 DAS after taking observation on weeds)

CCSHAU Hisar

The experimental plots were dominated by *Echinochloa crusgalli* followed by *Dactyloctenium aegyptium* and *Leptochloa chinensis*.

Density of *E. crusgalli*, *D. aegyptium* and total weed density at 20 DAS was reduced with delay in first irrigation from 7 DAS to 21 DAS. Among the herbicidal treatments, pre-emergence application of pendimethalin 30 EC 1000g/ha resulted in significantly lower density of *E. crusgalli* compared to penoxsulam + pendimethalin and tank mix application of pendimethalin + pyrazosulfuron-ethyl. Penoxsulam + pendimethalin resulted in maximum reduction in *L. chinensis* compared to pendimethalin, pendimethalin + pyrazosulfuron-ethyl. Timing of irrigation did not show any significant effect on yield parameters and yield of rice. Hand weeding (20, 40 and 60 DAS) resulted in higher grain yield (4.5 t/ha), which was at par with pendimethalin + pyrazosulfuron-ethyl (TM) as PE *fb* 1 HW but significantly higher than all other treatments.

Among the weed management treatment, the treatment pendimethalin + pyrazosulfuron-ethyl (TM) as PE *fb* 1 HW recorded highest grain yield of 4.3 t/ha whereas, among the timing of first irrigation, application of first irrigation at 7 DAS registered the highest grain yield of 3.2 t/ha.

GBPUAT, Pantnagar

Paspalum distichum, Panicum maximum, Echinochloa colona, Ischaemum rugosum and *Eleusine indica* among the grasses, *Alternanthera sessilis* and *Cyanotis axillaris* among the broadleaf weeds and the sedges *Cyperus iria, Fibmbristylis miliacea* and *Cyperus rotundus* were the major weeds recoded in the experiment.

Alternanthera sessilis and *Fimbristylis miliacea* were completely controlled by penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* bispyribac–sodium 25 g/ha as PoE (25-30 DAS) and penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* fenoxaprop-ethyl 67g/ha + ethoxysulfuron 18 g/ha as PoE (25-30 DAS). Pendimethalin + pyrazosulfuron-ethyl (RM) 785 g/ha as PE *fb* 1HW at 30 DAS also controlled *Fimbristylis miliacea* and *Caesulia axillaris* completely. Whereas, lowest weed density and dry matter accumulation of *Cyperus rotundus* were observed in pendimethalin+ pyrazosulfuron-ethyl (RM) 785 g/ha as PE *fb* 1 HW at 30 DAS. *Echinochloa colona* & *Ischaemum rugosum* were completely controlled by penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* fenoxaprop ethyl 67g/ha + ethoxysulfuron 18 g/ha as PoE (25-30 DAS), pendimethalin 678 g/ha (38.7 CS) as PE *fb* bispyribac-sodium 25 g/ha + [(MSM + chlorimuron ethyl) (RM)] 4 g/ha (TM) as PoE (25-30 DAS) and pendimethalin 678

g/ha (38.7 CS) as PE *fb* penoxsulam + cyhalofop-butyl (RM) 135 g/ha as PoE (25-30 DAS).

Combination of timing of first irrigation and either of the weed management treatments resulted in complete elimination of *Eleusine indica* among the grassy weeds except two hand weeding at 30 & 60 DAS, whereas combination of weed management treatment penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* fenoxaprop ethyl 67g/ha + ethoxysulfuron 18 g/ha as PoE (25-30 DAS) with first irrigation (14 DAS) resulted in complete elimination of *Paspalum distichum,* among the grassy weeds compared to other weeds. Yield and yield attributes were non-significantly recorded by time of irrigation (14 & 21 DAS); however, these were significantly varied among the weed management treatments.

In case of timing of irrigation, highest grain yield (4.4 t/ha), net returns (Rs. 76,635/ha) and B:C (2.7) were achieved with 1st irrigation at 14 DAS and among the weed management treatments pendimethalin 678 g/ha (38.7 CS) as PE *fb* bispyribac sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (TM) as PoE (25-30 DAS) recorded highest grain yield (4.5 t/ha), comparable net returns (Rs. 81, 105/ha) and highest B:C (2.9) **(Table 1.1.1).**

Table 1.1.1. Effect of timing of first irrigation and weed management treatments on weed control efficiency at 60 DAS, grain yield and economics of rice under DSR during *Kharif* season

Treatments	Weed control efficiency (%)	Grain yield (t/ha)	Net Returns (Rs./ha)	B:C
Main plot: Timing of first irrigation				
14 DAS	72.3	4.4	76635	2.7
21 DAS	78.8	4.3	75409	2.6
SEm±	-	**0.18**		
LSD (P=0.05)	-	**NS**		
Sub-plot: Weed management				
Pendimethalin + pyrazosulfuron-ethyl (RM) 785 g/ha PE *fb* 1 HW at 30 DAS	92.8	4.4	78515	2.7
Penoxsulam + pendimethalin (RM) 625 g/ha PE *fb* bispyribac–sodium 25 g/ha PoE (25-30 DAS)	77.8	4.3	81217	2.8
Penoxsulam + pendimethalin (RM) 625 g/ha PE *fb* fenoxaprop ethyl 67g/ha + ethoxysulfuron 18 g/ha PoE (25-30 DAS)	83.3	4.5	79144	2.7
Pendimethalin 678 g/ha (38.7 CS) PE *fb* bispyribac sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (TM) PoE (25-30 DAS)	95.4	4.5	81105	2.9
Pendimethalin 678 g/ha (38.7 CS) PE *fb* penoxsulam + cyhalofop-butyl (RM) 135 g/ha PoE (25-30 DAS)	94.4	4.5	81507	2.8
2 HW at 30 and 60 DAS	88.1	4.5	76198	2.5
Partially weedy check (Weeds will be removed at 60 DAS after taking observation on weeds)	-	3.6	54469	2.2
SEm±	-	0.19		
LSD (P=0.05)	-	0.57		

SKUAST, Jammu

The experimental plots were infested with *Echinochloa* sp., *Digitaria sanguinalis Caesulia axillaris, Physalis minima, Cyperus rotundus, Commelina benghalensis, Alternanthera philoxeroides, Phyllanthus niruri* and *Dactyloctenium aegyptium* during *Kharif* season.

Among the weed management treatments pendimethalin + pyrazosulfuron-ethyl 785 g/ha as PE *fb* 1 HW at 30 was recorded lower weed density and weed

biomass at 20, 40 and 60 DAS than other treatments. However, pendimethalin 1000 g/ha as PE *fb* bispyribac-sodium 25 g/ha + metsulfuron methyl + chlorimuron ethyl 4 g/ha as PoE (25-30 DAS) gave statistically similar response with respect to weed density at 40 DAS and at 60 DAS. Timings of first irrigation did not have significant influenced on yield attributes and yields of rice. However, first irrigation at 21 DAS recorded higher values of yield attributes and yields than first irrigation at 14 DAS.

Among the weed management treatments, higher grain yield (2.98 t/ha), highest net returns (Rs. 108397/ha) and B:C (3.10) were recorded in pendimethalin 1000 g/ha as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (TM) as PoE (25-30 DAS) closely followed by penoxsulam + pendimethalin 625 g/ha as PE *fb* fenoxaprop ethyl 67g/ha + ethoxysulfuron 18 g/ha as PoE **(Table 1.1.2).**

Table 1.1.2. Effect of timing of first irrigation and weed management treatments on yields and economics of rice under DSR.

Treatments	Grain yield (t/ha)	Straw yield (t/ha)	Cost of cultivation (Rs. /ha)	Net returns (Rs./ha)	B:C
Timing of first irrigation					
14 DAS	2.73	4.93	36328	95017	2.62
21 DAS	2.77	5.18	36328	97297	2.68
SEm ±	0.07	0.78	-	-	-
L.S.D (P=0.05)	N. S	N. S	-	-	-
Weed management					
Pendimethalin + pyrazosulfuron-ethyl 785 g/ha as PE *fb* 1 HW	2.99	5.38	39003	104812	2.69
Penoxsulam + pendimethalin 625 g/ha as PE *fb*bispyribac–sodium 25 g/ha as PoE	2.73	4.85	34741	96444	2.78
Penoxsulam + pendimethalin 625 g/ha as PE *fb* fenoxaprop ethyl 67g/ha + ethoxysulfuron 18 g/ha as PoE	2.94	5.17	35140	106030	3.02
Pendimethalin 1000 g/ha as PE *fb* bispyribac-sodium 25 g/ha + metsulfuron-methyl + chlorimuron-ethyl 4 g/ha as PoE	2.98	5.37	34953	108397	3.10
Pendimethalin 1000 g/ha as PE *fb* penoxsulam + cyhalofop -butyl 135 g/ha as PoE	2.97	5.23	36143	106482	2.95
HW at 30 and 60 DAS	3.01	5.31	43660	100905	2.31
Partially weedy check	1.64	4.09	30660	50500	1.65
SEm ±	0.11	0.10		-	-
LSD (P=0.05)	0.33	0.28		-	-

Weed management in *tar-vattar* direct-seeded rice (DSR) – a comparison of results at different centres

	CCSHAU, Hisar	GBPUAT, Pantnager	SKUAST, Jammu
Timing of first irrigation	Application of first irrigation at 7 DAS registered the highest grain yield of 3.2 t/ha.	Application of first irrigation at 14 DAS registered highest grain yield of 2.7 t/ha, net returns of Rs. 76,635/ha and BC ratio of 2.7.	Timings of first irrigation did not have significant influenced on yield attributes and yields of rice. However, first irrigation at 21 DAS recorded higher values of yield attributes and yields than first irrigation at 14 DAS.

Table contd...

Promising weed management treatment	Among the weed management treatment, pendimethalin + pyrazosulfuron-ethyl (Tank-mix) as PE *fb* 1 HW (30 DAS) recorded highest grain yield of 4.3 t/ha	Pendimethalin 678 g/ha (38.7 CS) as PE *fb* bispyribac sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (Tank-mix) as PoE (25-30 DAS) recorded highest grain yield of 2.9 t/ha, comparable net returns of Rs. 81, 105/ha and highest BC ratio of 2.9.	Pendimethalin 1000 g/ha as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron -ethyl) (RM)] 4 g/ha (Tank-mix) as PoE (25-30 DAS) recorded higher grain yield of 2.98 t/ha, highest net returns of Rs. 108397/ha and BC ratio 3.10.

WP-1.1.2. Weed management in dry direct-seeded rice (DSR)

Network centres: IGKVV Raipur, OUAT Bhubaneswar, CSKHPKV Palampur, PAJANCOA & RI Puducherry, UAS Bengaluru, BCKV Kalyani, BAU Sabour, BUAT Banda

Treatments:

T1 - Pendimethalin + pyrazosulfuron-ethyl (RM) 785 g/ha as PE *fb* 1 HW at 30 DAS

T2 - Penoxsulam + pendiemthalin (RM) 625 g/ha as PE *fb* bispyribac –sodium 25 g/ha as PoE (25-30 DAS)

T3 - Penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* fenoxaprop ethyl 67g/ha + ethoxysulfuron 18 g/ha as PoE (25-30 DAS)

T4 - Pendimethalin 1000 g/ha (30 EC) or 678 g/ha (38.7 CS) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (TM) as PoE (25-30 DAS)

T5 - Pendimethalin 1000 g/ha (30 EC) or 678 g/ha (38.7 CS) as PE *fb* penoxsulam + cyhalofop-butyl (RM) 135 g/ha as PoE (25-30 DAS)

T6 - 2 HW at 30 and 60 DAS

T7 - Partially weedy check (1HW at 60 DAS)

IGKVV, Raipur

The major weed flora during the *Kharif* season was *Alternanthera triandra, Cyanotis axillaris, Echinochloa colona* and *Cyperus iria*.

Among the chemical weed control treatments, pendimethalin 1000 g/ha (30EC) as PE *fb* bispyribac-sodium 25 g/ha + (metsulfuron methyl + chlorimuron ethyl) (RM) 4 g/ha (Tank-mix) as PoE (25-30 DAS) was found very effective to control the weeds at all the stages. Minimum weed density and weed biomass was recorded under this treatment having statistically at par with the 2HW at 30 & 60 DAS. Highest weed control efficiency at 20 and 40 days after sowing was also recorded by this treatment.

Significantly highest grain yield (6.69 t/ha), highest net returns (Rs.115014/ha) and highest B:C (3.71) was recorded under the treatment pendimethalin 1000 g/ha (30 EC) as PE *fb* bispyribac-sodium 25 g/ha + (metsulfuron-methyl + chlorimuron-ethyl) (RM) 4 g/ha (Tank-mix) as PoE (25-30 DAS) closely followed by pendimethalin 1000 g/ha (30EC) PE *fb* penoxsulam + cyhalofop-butyl (RM) 135 g/ha as PoE (25-30 DAS) **(Table 1.1.3).**

Table 1.1.3. Effect of weed management treatments on weed control efficiency, grain yield and economics of rice under DSR during *Kharif* season.

Treatments	Weed control efficiency (%)		Grain yield (t/ha)	Net returns (Rs/ha)	B:C
	20 DAS	40 DAS			
Pendimethalin + pyrazosulfuron-ethyl (RM) 785 g/ha (PE) *fb* 1HW at 30 DAS	88.48	86.29	6.08	99937	3.05
Penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* bispyribac sodium 25 g/ha as PoE (25-30 DAS)	75.88	84.61	5.89	97826	3.18
Penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* fenoxaprop ethyl 67 g/ha + ethoxysulfuron 18g/ha as PoE (25-30 DAS)	81.20	87.91	6.30	105655	3.31

Table contd...

Pendimethalin 1000g/ha (30EC) as PE *fb* bispyribac sodium 25 g/ha + (metsulfuron-methyl + chlorimuron - ethyl) (RM) 4 g/ha (TM) PoE (25-30 DAS)	71.28	91.30	6.69	115014	3.71
Pendimethalin 1000g/ha (30EC) PE *fb* penoxsulam + cyhalofop butyl (RM) 135g/ha PoE (25-30 DAS)	70.16	87.29	6.51	109874	3.41
2HW at 30 & 60 DAS	11.06	91.29	6.40	104935	3.02
Partially weedy check (1HW at 60 DAS)	-	-	2.92	32650	0.98
SEm±			0.07	-	-
LSD (P= 0.05)			0.22	-	-

OUAT, Bhubaneswar

The floristic composition of the experimental site was dominated with grasses like *Digitaria ciliaris, Cynodon dactylon, Echinochloa colona* and broadleaf weeds like *Ageratum conyzoides, Cleome viscosa, Celosia argentia Oldenlandia corymbosa, Ludwigia parviflora, Physalis minima* and *Amaranthus viridis.* The dominant sedges were *Cyperus rotundus* and *Cyperus iria.*

Among different herbicide combinations, application of penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* fenoxaprop-ethyl 67 g/ha + ethoxysulfuron 18 g/ha as PoE (25 DAS) recorded significantly lowest weed biomass at 20, 40 and 60 DAS, followed by pendimethalin 1000 g/ha (30 EC) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (Tank-mix) as PoE (25 DAS) and pendimethalin 1000 g/ha (30 EC) as PE *fb* penoxsulam + cyhalofop-butyl (RM) 135 g/ha as PoE (25DAS).

Among the weed management treatments penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* fenoxaprop-ethyl 67g/ha + ethoxysulfuron 18 g/ha as PoE (25 DAS) recorded significantly highest grain yield of 3.82 t/ha, highest net returns of Rs.20809/ha and BC ratio of 2.81.

CSKHPKV, Palampur

Weed flora in the experimental field during first week of July was composed of *Cyperus* sp. (30%), *Ageratum* sp. (29%), *Polygonum alatum* (19%) and *Commelina* sp. (15%), *Digitaria sanguinalis* (4%), *Echinochloa colona* (3%), *Galinsoga parviflora* and *Ipomoea* 1% each and *Aeschynomene indica.* During maturity *Ageratum* sp. constituted 93% of the total weed flora in the experimental field.

Pendimethalin 1000 g/ha *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (Tank-mix) as PoE (25-30 DAS) effectively reduced the total weed biomass during both the years of experimentation.

Pendimethalin 1000 g/ha *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha as PoE (25-30 DAS) registered highest grain yield of 2.8 t/ha, highest net returns due to weed control (Rs. 49341/ha) and MBCR (10.61) **(Table 1.1.4)**.

Table 1.1.4. Effect of treatments on grain yield and economics of direct-seeded rice

Treatment	Grain yield (t/ha)			Gross Returns (Rs/ha)			Cwc	GRw	NRw	MBCR
	2022	2023	Mean	2022	2023	Mean				
Pendimethalin - pyrazosulfuron-ethyl *fb* HW	2.43	2.63	2.53	88642	89679	89161	10983	47292	36309	3.31
Penoxsulam + pendiemthalin *fb* bispyribac	2.97	1.86	2.42	109225	68141	88683	4185	46814	42630	10.19

Table contd...

Penoxsulam + pendimethalin *fb* fenoxaprop ethyl + ethoxysulfuron	2.86	2.58	2.72	101472	88500	94986	5145	53118	47972	9.32
Pendimethalin *fb* bispyribac-sodium + metsulfuron methyl + chlorimuron ethyl	2.38	3.18	2.78	85790	105928	95859	4650	53991	49341	10.61
Pendimethalin *fb* penoxsulam + cyhalofop-butyl	2.67	2.14	2.41	97989	76782	87386	7448	45517	38069	5.11
Pretilachlor PE *fb* penoxulam + cyhalofop butyl	2.64	2.09	2.36	96570	75449	86010	6358	44141	37783	5.94
HW twice	2.97	1.71	2.34	108984	63449	86217	24675	44348	19673	0.80
Weedy check*	1.75	0.38	1.06	60453	23285	41869	18725	0	-18725	-1.00
SE(m±)	0.14	0.25		4668	6424	5546				
LSD(P=0.05)	0.43	0.77		14161	19487	16824				

Cwc, cost of weed control; GRw, gross returns due to weed control; NRw, net returns due to weed control; MBCR, marginal benefit cost ratio; Partially weed check during 2022 (weeds removed on 60 DAS).

PAJANCOA & RI, Puducherry

Experimental field was dominated by sedges (67.7%), broadleaf weeds (3.6%) and grasses (28.7%). Predominant weeds of the experimental field were *Echinochloa colona* Link., *Digitaria marginata* Stapf, *Panicum repens* L., *Dactyloctenium aegyptium* (L.) Willd., *Cyperus difformis* L., *Eclipta alba* (L.) Hassk, *Corchorus tridens* L., *Phyllanthus niruri* L. and *Aeschynomene indica* L. at 60 DAS.

Sequential application of penoxsulam + pendimethalin 625 g/ha as PE *fb* fenoxaprop-ethyl 67 g/ha + ethoxysulfuron 18 g/ha as PoE (25-30 DAS) has recorded lowest total weed density (5.2 no./m^2) and highest weed control efficiency (95.8%) at 60 DAS.

Sequential application of penoxsulam + pendimethalin 625 g/ha as PE *fb* fenoxaprop-ethyl 67 g/ha + ethoxysulfuron 18 g/ha as PoE (25-30 DAS) has registered highest grain yield of 3.39 t/ha, highest net returns of Rs. 44100/ha and BC ratio of 1.44 in dry direct-seeded rice.

UAS, Bengaluru

The weed flora observed in the experimental plots were sedges–*Cyperus rotundus*, Grasses - *Eleusine indica*, *Digitaria marginata* and *Cynodon dactylon*. In broadleaf weeds – *Borreria hispida, Ageratum conyzoides, Commelina benghalensis, Acanthospermum hispidum, Celosia argentea, Cleome viscosa* and *Argemone mexicana* were the dominant weed species. Among the total weed density, the value of broadleaf weeds (*Borreria hispida, Ageratum conyzoides* and *Commelina benghalensis*) was higher than that of grasses and sedges.

Among the different weed management treatments, pendimethalin + pyrazosulfuron-ethyl (RM) 785 g/ha as PE *fb* 1 HW at 30 DAS recorded the highest weed control efficiency of 65.83 % at 20 DAS**.** At 40 DAS and 60 DAS, pendimethalin 1000 g/ha (30 EC) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (Tank-mix) as PoE (25 DAS) recorded the highest weed control efficiency of 71.41 % and 70.56%, respectively.

Sequential application of pendimethalin 1000 g/ha (30 EC) as PE *fb* bispyribac–sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (TM) as PoE (25 DAS) recorded the highest grain of 1.32 t/ha, highest net returns of Rs. 39,670/ha and BC ratio of 2.06.

BCKV, Kalyani

The dominant weeds appeared in the experimental plots were *Echinochloa colona, Leersia*

hexandra, Cynodon dactylon among the grasses; *Cyperus iria, Cyperus difformis, Fimbristylis dichotoma* among the sedges, *Alternanthera philoxeroides, Ludwigia octovalvis, Ammannia baccifera* and *Eclipta alba* among the broadleaf weeds.

At 60 DAS, the highest weed control efficiency (WCE) of 84.80% was recorded in the treatment pendimethalin 1000 g/ha (30 EC) or 678 g/ha (38.7 CS) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (TM) as PoE (25-30 DAS) and was followed by penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* fenoxaprop-ethyl 67 g/ha + ethoxysulfuron 18 g/ha as PoE (25-30 DAS) having WCE of about 79.39%.

Sequential application of pendimethalin 1000 g/ha (30 EC) or 678 g/ha (38.7 CS) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (TM) as PoE (25-30 DAS) recorded significantly highest grain yield of 4.90 t/ha, highest net returns of Rs. 56624/ha and BC ratio of 2.21.

BAU, Sabour

The dominant weeds observed at the experimental site were *Echinochloa colona, Echinochloa crusgalli, Eleusine indica, Cynodon dactylon, Digitaria sanguinalis* among the grasses, *Cyperus rotundus, Cyperus iria, Cyperus difformis, Fimbristylis miliaceae* among the sedges, *Alternanthera sessilis, Caesulia axillaris, Ludwigia parviflora, Eclipta alba, Phyllanthus niruri, Amaranthus viridis, Physalis minima, Commelina benghalensis* among the broadleaf weeds.

Among the weed management treatments, the lowest weed density (6.00/m^2 and 4.32/m^2) and weed dry weight (6.49g/m^2 and 4.11g/m^2) were recorded by penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* bispyribac–sodium 25 g/ha as PoE (25-30 DAS) at 40 and 60 DAS, respectively. Maximum grain yield (5.53 t/ha) was recorded in 2 HW treatment followed by pendimethalin 1000 g/ha (30 EC) or 678 g/ha (38.7 CS) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (Tank-mix) as PoE (25-30 DAS) (4.96 t/ha).

Among the treatments, the highest net returns (Rs. 90,063/ha) was recorded in 2 HW treatment followed by pendimethalin + pyrazosulfuron-ethyl (RM) 785 g/ha as PE *fb* 1HW at 30 DAS (Rs. 88,016/ha). Highest BC ratio of 2.32 was recorded in pendimethalin 1000 g/ha (30 EC) or 678 g/ha (38.7 CS) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (TM) as PoE (25-30 DAS).

BUAT, Banda

The experimental field of rice was infested with several grasses, sedges and broadleaf weeds. The major weeds species were *Echinochloa crusgalli, Brachiaria reptans, Digera arvensis, Centella asiatica, Phyllanthus niruri, Cyperus rotundus.* etc. At 20 DAS only a few grasses, broadleaf weeds and sedges were observed, while at 40 DAS and 60 DAS higher number of grasses and broadleaf weeds were observed. Weed population increased with advancement of crop stages.

Pendimethalin 1000 g/ha (30 EC) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha as PoE (25-30 DAS) significantly reduced the weed dry weight (8.4 g, 12.9 g 22.9 g/m^2) at all three stages, respectively, and thus registered highest weed control efficiency among the weed management treatments.

Highest rice grain yield of 4.0 t/ha with BC ratio of 2.62 was obtained in the treatment pendimethalin 1000 g/ha (30 EC) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha as PoE (25-30 DAS), which was closely followed by pendimethalin 1000 g/ha (30 EC) as PE *fb* penoxsulam + cyhalofop-butyl (RM) 135 g/ha as PoE (25-30 DAS).

Weed management in dry direct-seeded rice (DSR) – a comparison of results at different centres

	IGKVV, Raipur	OUAT, Bhubaneswar	CSKHPKV, Palampur	PAJANCOA & RI, Puducherry	UAS, Bengaluru	BAU, Sabour	BUAT, Banda	BCKV, Kalyani
Promising weed management treatment	Pendimethalin 1000 g/ha (30 EC) as PE *fb* bispyribac-sodium 25 g/ha + (metsulfuron-methyl + chlorimuron-ethyl) (RM) 4g/ha (Tank-mix) as PoE (25-30 DAS) recorded highest grain yield of 6.69 t/ha, highest net returns of Rs.115014/ha and BC ratio of 3.71.	Penoxsulam + pendimethalin (RM) 625 g/ha as PE *fb* fenoxaprop-ethyl 67g/ha + ethoxysulfuron 18 g/ha (Tank-mix) as PoE (25 DAS) recorded highest grain yield of 3.82 t/ha, highest net returns of Rs.20809/ha and BC ratio of 2.81.	Pendimethalin 1000 g/ha (30 EC) *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (Tank-mix) as PoE (25-30 DAS) registered highest grain yield of 2.8 t/ha, highest net returns due to weed control (Rs. 49341/ha) and MBCR (10.61).	Penoxsulam + pendimethalin 625 g/ha as PE *fb* fenoxaprop-ethyl 67 g/ha + ethoxysulfuron 18 g/ha (Tank-mix) as PoE (25-30 DAS) registered highest grain yield of 3.39 t/ha, highest net returns of Rs. 44100/ha and BC ratio of 1.44.	Pendimethalin 1000 g/ha (30 EC) as PE *fb* bispyribac–sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (Tank-mix) as PoE (25 DAS) recorded highest grain of 1.32 t/ha, highest net returns of Rs. 39,670/ha and BC ratio of 2.06.	Pendimethalin 1000 g/ha (30 EC) or 678 g/ha (38.7 CS) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (Tank-mix) as PoE (25-30 DAS) recorded higher grain yield of 4.96 t/ha and highest BC ratio of 2.32. However, highest value of net returns (Rs.88,016/ha) was registered by pendimethalin + pyrazosulfuron-ethyl (RM) 785 g/ha as PE *fb* 1HW at 30 DAS	Pendimethalin 1000 g/ha (30 EC) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-methyl + chlorimuron-ethyl) (RM)] 4 g/ha (Tank-mix) as PoE (25-30 DAS) recorded highest grain yield of 4.0 t/ha with BC ratio of 2.62.	Pendimethalin 1000 g/ha (30 EC) or 678 g/ha (38.7 CS) as PE *fb* bispyribac-sodium 25 g/ha + [(metsulfuron-ethyl + chlorimuron-ethyl) (RM)] 4 g/ha (Tank-mix) as PoE (25-30 DAS) recorded highest grain yield of 4.90 t/ha, highest net returns of Rs. 56624/ha and BC ratio of 2.21.

WP-1.1.3. Weed management in sorghum

Network Centres: MPUAT Udaipur, RVSKVV Gwalior, PJTSAU Hyderabad, SKNAU Jobner, ANGRAU Guntur

Treatments:

Treatment	Dose	Time of application
Atrazine *fb* 2,4-D Ethyl ester	750 g/ha *fb* 500 g/ha	PE *fb* PoE (20 DAS)
Atrazine *fb* 2,4-D dimethylamine salt	750 g/ha *fb* 750 g/ha	PE *fb* PoE (20 DAS)
Atrazine + Mesotrione (RM)	438 g/ha	PoE (20 DAS)
Atrazine + Mesotrione (RM)	656 g/ha	PoE (20 DAS)
Atrazine + Topramezone (TM)	(500 +18.9) g/ha	EPoE (15 DAS)
Atrazine + Topramezone (TM)	(500 +25.2) g/ha	EPoE (15 DAS)
Atrazine *fb* Mechanical weeding at 30 DAS	500 g/ha	PE
Bentazone	960 g/ha	PoE (20 DAS)
Weed free (HW at 20 & 40 DAS)		
Weedy check		

MPUAT, Udaipur

The dominant weed flora was *Echinochloa colona* (51.75%), *Eleusine indica* (29.85%), *Digera arvensis* (3.99%), *Commelina benghalensis* (7.96%), *Setaria glauca* (3.48%) *and Physalis minima* (2.99%).

At 40 DAS, application of atrazine + topramezone (Tank-mix) (500 +18.9) g/ha EPoE (15 DAS), atrazine + topramezone (Tank-mix) (500+25.2) g/ha EPoE (15 DAS), atrazine *fb* mechanical weeding at 30 DAS and weed-free (HW at 20 & 40 DAS) resulted in zero total weed density and dry matter, and thus resulted in 100% weed control efficiency.

Maximum seed yield (3.20 t/ha) of sorghum was recorded with weed-free (HW at 20 & 40 DAS) and it was followed by atrazine 500 g/ha *fb* mechanical weeding at 30 DAS (2.90 t/ha), atrazine + topramezone (TM) (500 +18.9) g/ha as EPoE (15 DAS) (2.65t/ha), atrazine 750 g/ha as PE *fb* 2,4-D ethyl ester 500 g/ha as PoE (20 DAS) (2.65t/ha). Highest net returns (Rs. 65048/ha) and BC ratio (3.19) was realized with atrazine 500 g/ha as PE *fb* mechanical weeding at 30 DAS, which was followed by atrazine 750 g/ha as PE *fb* 2,4-D ethyl ester 500 g/ha as PoE (20 DAS) (Rs 59337/ha). Atrazine + topramezone (TM) (500 +25.2) g/ha as EPoE (15 DAS), atrazine + topramezone (Tank-mix) (500 +18.9) g/ha as EPoE (15 DAS) and atrazine + mesotrione (RM) 656 g/ha as PoE (20 DAS) resulted in phyto-toxicity symptoms on the crop; however, crop plants gradually recovered with the progress of time.

RVSKVV, Gwalior

Weeds recorded in the experimental plots were *Setaria glauca, Echinochloa colona, Acrachne racemosa, Brachiaria reptans,* and *Cynodon dactylon* as grasses, *Commelina benghalensis, Bryophyllum pinnatum, Phyllanthus niruri* and *Digera arvensis* as broadleaf weeds and *Cyperus rotundus* as sedge. Out of 10 above species recorded in the sorghum crop, two major weeds found in respect to relative density were *Cyperus rotundus* (45.29% in 2022 and 61.50% in 2023) and *Echinochloa colona* (11.10% in 2022 and 18.09% in 2023) at 20 DAS; however, at 40 and 60 DAS only one weed *Cyperus rotundus* (76.61% and 85.37% in 2022 and 80.86% and 80.64% in 2023, respectively) appeared as the dominant weed.

Maximum weed control efficiency (50.39%) was recorded with the application of atrazine (500 g/ha) *fb* mechanical weeding at 30 DAS followed by atrazine 750 g/ha as PE *fb* 2,4-D ethyl ester 500 g/ha as PoE (20 DAS) (42.76%), whereas, after 40 days of sowing, the maximum weed control efficiency (74.02%) was recorded where atrazine (500 g/ha) with mechanical weeding at 30 DAS followed by post-emergence application of bentazone (960 g/ha) (60.32%). However, at 60 DAS the maximum weed control efficiency (59.11%) was recorded with the post-emergence application of bentazone (960 g/ha) at 20 DAS. Among

the different herbicidal treatments, maximum grain yield (2.20 t/ha), net returns (Rs.77901/ha) and BC ratio (4.0) were recorded in the treatment atrazine + mesotrione (RM) (656 g/ha) as PoE (20 DAS) **(Table 1.1.5).**

Based on two years' experimentation, it has been concluded that the population of narrow and broadleaf weeds continued to be less up to 40 DAS with integrated weed management practice where atrazine (500 g/ha) as PE *fb* mechanical weeding at 30 DAS was applied. However, post-emergence application of atrazine + mesotrione (RM) provided the maximum grain and stover yield, gross and net returns. Therefore, among the different weed management practices, the atrazine (500 g/ha) as PE *fb* mechanical weeding at 30 DAS and atrazine + mesotrione (RM) (656 g/ha) as PoE (20 DAS) can control narrow and broadleaf weeds effectively and that led to higher productivity and profitability of sorghum.

Table 1.1.5. Effect of treatments on grain yield and economics of sorghum

Treatments	Dose	Grain yield (t/ha)			Net returns (Rs/ha)			B:C		
		2022	2023	Pooled	2022	2023	Pooled	2022	2023	Pooled
Atrazine *fb* 2,4-D Ethyl ester	750 g/ha *fb* 500 g/ha as PoE	2.31	1.91	2.11	76269	72335	74302	4.03	3.74	3.88
Atrazine *fb* 2,4-D dimethylamine salt	750 g/ha *fb* 750 g/ha as PoE	2.16	1.89	2.02	69802	71584	70693	3.79	3.72	3.76
Atrazine + Mesotrione (RM)	438 g/ha as PoE	2.51	1.78	2.14	84916	65251	75083	4.35	3.45	3.90
Atrazine + Mesotrione (RM)	656 g/ha as PoE	2.61	1.80	2.20	89260	66543	77901	4.51	3.49	4.00
Atrazine + Topramezone (TM)	(500+18.9) g/ha as EPoE	2.36	1.66	2.01	78641	59618	69129	4.14	3.27	3.71
Atrazine + Topramezone (TM)	(500+25.2) g/ha as EPoE	2.38	1.60	1.99	79330	56097	67713	4.12	3.10	3.61
Atrazine *fb* Mechanical weeding at 30 DAS	500 g/ha as PE	2.33	1.97	2.15	76025	74008	75016	3.87	3.66	3.76
Bentazone	960 g/ha as PoE	2.23	1.93	2.08	72214	72640	72427	3.78	3.67	3.73
Weed free (HW at 20 & 40 DAS)		2.58	2.16	2.37	86532	83448	84990	4.20	3.94	4.07
Weedy check		1.48	1.58	1.53	43078	58808	50943	2.95	3.55	3.25
SEm (±)		0.14	0.17	0.11						
LSD (P=0.05)		0.42	0.51	0.32						

PJTSAU, Hyderabad

At 30 DAS, the highest weed control efficiency was recorded in atrazine + mesotrione 656 g/ha as PoE followed by atrazine + halosulfuron-methyl at both the doses and atrazine *fb* 2,4-D ethyl ester (750 & 500 g/ha). At 60 DAS, the values of weed control efficiency with atrazine + halosulfuron-methyl 500 +50.6 g/ha and 500 +67.5 g/ha were higher than other treatments. Severe yellowing of sorghum leaves was observed at 7 DAA with atrazine + mesotrione (RM) at both the doses (438 g/ha and 656 g/ha). Stunting of the sorghum plants was observed in atrazine + halosulfuron-methyl 500 +50.6 g/ha and 500 +67.5 g/ha.

Among the weed management treatments, higher grain yield of sorghum was recorded in atrazine *fb* 2,4-D ethyl ester (750 & 500 g/ha) (4.5 t/ha) and atrazine + topramezone (500 + 18.9 g/ha) (4.5 t/ha) and both were at par with weed-free treatment (HW at 20 & 40 DAS) (4.9 t/ha). The Gross returns, net returns and BC ratio followed a similar trend. Highest BC ratio was recorded in weed-free treatment (4.77) followed by atrazine *fb* 2,4-D ethyl ester (750 & 500 g/ha) (4.56) and atrazine + topramezone (500 + 18.9 g/ha) (4.31) and atrazine *fb* 2,4-D ethyl ester (750 & 500 g/ha) (4.56) and atrazine + topramezone (500 + 18.9 g/ha) registered the net returns of Rs. 178557/ha.

Atrazine PE fb 2,4-D dimethyl amine salt PoE
(750 g/ha *fb* 750 g/ha)

Atrazine PE *fb* 2,4-D Ethyl ester PoE
(750 g/ha *fb* 500 g/ha)

Atrazine + Mesotrione (RM) PoE (438 g/ha)

Atrazine + Mesotrione (RM) PoE (656 g/ha)

SKNAU, Jobner

Maximum weed control efficiency was recorded in 2 HW, which was similar with atrazine 500 g/ha *fb* mechanical weeding (96.3%). Grain yield was recorded maximum in 2 HW, which was recorded at par with atrazine 500 g/ha *fb* mechanical weeding at 30 DAS (1.02 t/ha). After changing the doses in different treatments, atrazine + topramezone (TM) (500 +20) g/ha showed phyto-toxicity on sorghum crop, which was recovered after 15-20 days, otherwise none of the treatments showed phyto-toxicity.

ANGRAU, Guntur

Atrazine 500 g/ha as PE *fb* 2,4-D dimethyl amine salt 750 g/ha as PoE (20 DAS) recorded highest grain yield of 3.31 t/ha with BC ratio of 2.92. Atrazine 500 g/ha as PE *fb* 2,4-D dimethyl amine salt 750 g/ha has emerged as an effective weed management treatment without any phyto-toxicity on crop plants followed by the application of atrazine 500 g/ha as PE *fb* HW at 30 DAS. Tank-mix application of atrazine 500 g/ha + topramezone 14.17 g/ha and atrazine 500 g/ha + topramezone 18.9 g/ha applied at 15 DAS resulted in lesser weed density; however, showed phyto-toxicity on crop plants at 7 DAHA. Ready-mix application of atrazine + mesotrione 328 g/ha and atrazine + mesotrione 656 g/ha applied at 20 DAS showed phyto-toxicity on crop plants having rating of 1 in 0-10 scale at 7DAHA. The crop plants were recovered from phyto-toxicity by 30 DAS. In the treatments, the doses of post-emergence herbicides were reduced by 25% during 2022-23 due to severe phyto-toxicity of the herbicides on the crop plants at their previous doses.

Weed management in sorghum– a comparison of results at different centres

	MPUAT, Udaipur	RVSKVV, Gwalior	PJTSAU, Hyderabad	SKNAU, Jobner	ANGRAU, Guntur
Promising weed management treatment	Atrazine 500 g/ha *fb* mechanical weeding at 30 DAS recorded higher grain yield of 2.90 t/ha , highest net returns of Rs. 65048/ha and BC ratio 3.19.	Atrazine + mesotr ione (RM) 656 g/ha as PoE (20 DAS) recorded highest grain yield of 2.20 t/ha, net returns of Rs.77901/ha and BC ratio of 4.0.	Atrazine 750 g/ha as PE *fb* 2,4-D ethyl ester 500 g/ha as PoE (20 DAS) recorded higher grain yield of 4.46 t/ha, net returns of Rs. 178557/ha and BC ration of 4.56.	Atrazine 500 g/ha *fb* mechanical weeding at 30 DAS recorded higher grain yield of 1.02 t/ha.	Atrazine 500 g/ha as PE *fb* 2,4-D dimethyl amine salt 750 g/ha as PoE (20 DAS) recorded highest grain yield of 3.31 t/ha with BC ratio of 2.92.
Phyto-toxicity	Atrazine + topramezone (Tank - mix) (500 +25.2) g/ha as EPoE (15 DAS), atrazine + topramezone (Tank-mix) (500 +18.9) g/ha as EPoE (15 DAS) and a trazine + mesotrione (RM) 656 g/ha as PoE (20 DAS) showed phyto-toxicity on sorghum plants; however, plants gradually recovered with the progress of time.			Atrazine + topramezone (Tank - mix) (500 +20) g/ha as EPoE (15 DAS) showed phyto-toxicity on sorghum crop and the crop plants recovered after 15 -20 days after application of herbicide	Atrazine + mesotrione 328 g/ha and atrazine + mesotrione 656 g/ha applied as PoE (20 DAS) showed phyto-toxicity on crop plants having rating of 1 in 0-10 scale at 7DAHA. The crop plants recovered from phyto-toxicity within 30 DAS

WP-1.1.4. Weed Management in direct seeded/drill sown finger millet

Network Centres: UAS Bengaluru, IGKVV Raipur, PAJNCOA & RI Puducherry, ANGRAU Guntur

Treatments:

T1: Pyrazosulfuran-ethyl 15 g/ha as PE

T2: Atrazine 500 g/ha as PE

T3: Pyrazosulfuran-ethyl 15 g/ha as PE *fb* 2,4-D sodium salt 800 g/ha as PoE

T4: Atrazine 500 g/ha as PE *fb* 2, 4-D sodium salt 800 g/ha as PoE

T5: Pyrazosulfuran-ethyl 15 g/ha as PE *fb* metsulfuron-methyl + chlorimuron-ethyl 4 g/ha PoE

T6: Atrazine 500 g/ha as PE *fb* metsulfuron-methyl + chlorimuron-ethyl 4 g/ha PoE

T7: 2 HW at 20 & 40 DAS

T8: Weedy check

UAS, Bengaluru

Major weeds recorded in the experimental plots were *Cyperus rotundus* (Sedge), grasses – *Eleusine indica, Digitaria marginata,* and *Cynodon dactylon* and *Borreria hispida, Ageratum conyzoides, Commelina benghalensis, Oledenlandia corymbosa, Celosia argentea* and *Ionidium sulfruticosum* (Broadleaf weeds). Among the different categories of weeds, broadleaf weeds were recorded as dominant weed flora followed by grasses and sedge.

At 20 DAS, atrazine 500 g/ha as PE *fb* metsulfuron-methyl + chlorimuron-ethyl 4 g/ha as PoE followed by atrazine 500 g/ha as PE *fb* 2,4-D sodium salt 800 g/ha as PoE recorded the highest weed control efficiency (WCE) 58.66 % and 52.14%, respectively. Whereas at 40 DAS, two HW at 20 and 40 DAS followed by atrazine 500 g/ha as PE *fb* metsulfuron-methyl + chlorimuron-ethyl 4 g/ha as PoE recorded the highest WCE of 63.43% and 59.31%, respectively, while at later stages same treatments recorded the highest WCE compared to other treatments.

Two hand weeding at 20 DAS and 40 DAS recorded significantly highest grain and straw yield of 1.91 t/ha and 7.77 t/ha, respectively, which was on par with atrazine 500 g/ha as PE *fb* metsulfuron- methyl + chlorimuron-ethyl 4 g/ha as PoE (1.88 and 7.65 t/ha, respectively). Among the weed management treatments, highest values of net returns and BC ratio were obtained in atrazine 500 g/ha as PE *fb* metsulfuron-methyl + chlorimuron-ethyl 4 g/ha (Rs. 38,000/ha and 2.37). Atrazine 500 g/ha as PE *fb* metsulfuron-methyl + chlorimuron-ethyl 4 g/ha, atrazine 500 g/ha as PE *fb* 2,4-D sodium salt 800 g/ha and pyrazosulfuran-ethyl 15 g/ha as PE *fb* metsulfuron-methyl + chlorimuron-ethyl 4 g/ha as PoE were found effective in controlling weeds and could be the alternative for manual weeding. Pyrazosulfuran-ethyl 15g/ha as PE and atrazine 500 g/ha as PE showed phyto-toxicity on crop by delaying the germination of ragi seeds up to 18 days after herbicide spray (DAHS). However, there was no phyto-toxic effect on new flushes of crop growth as seeds germinated fully after 25 days after herbicide spray.

Atrazine 500 g/ha as PE *fb* metsulfuron methyl + chlorimuron ethyl 4 g/ha as PoE at 30 DAS

Pyrazosulfuran-ethyl 15 g/ha as PE *fb* metsulfuron methyl + chlorimuron ethyl 4 g/ha as PoE at 30 DAS

2 Hand weeding at 20 and 40 DAS at 30 DAS

Atrazine 500g/ha as PE *fb* 2,4-D sodium salt 800 g/ha as PoE at 30 DAS

Pyrazosulfuran-ethyl 15g/ha as PE *fb* 2,4-D sodium salt 800 g/ha as PoE at 30 DAS

Weedy check at 30 DAS

IGKVV, Raipur

The experimental field was infested with different weeds namely *Echinochloa colona, Alternanthera triandra, Celosia argentea, Cyperus iria, Physalis minima, Cyanotis axillaris* and *Dinebra retroflexa.*

Among the treatments, atrazine 500 g/ha as PE *fb* 2,4-D sodium salt 800 g/ha as PoE produced the lowest weed biomass, achieved highest weed control efficiency (72.37, 90.11 and 73.77% at 20, 40 and 60 DAS, respectively), and highest grain yield (1.75 t/ha), net returns (Rs. 45,110/ha) and BC ratio (3.03).

Atrazine 500 g/ha as PE *fb* 2,4-D sodium salt 800 g/ha as PoE has appeared as effective weed management treatment and it was closely followed by the treatment atrazine 500 g/ha as PE *fb* metsulfuron-methyl + chlorimuron-ethyl 4 g/ha PoE in terms of producing grain yield and net returns.

PAJNCOA & RI, Puducherry

Hand weeding twice significantly reduced the weed density and resulted in higher weed control efficiency and grain yield of finger millet (1.05 t/ha). In general, pyrazosulfuran-ethyl 15 g/ha as PE consistently exhibited minimal phyto-toxicity; however, atrazine 500 g/ha as PE consistently showed severe phyto-toxicity with the value of 10 at the phyto-toxicity rating scale of 0 to 10 on all observation days, indicating complete mortality of crop plants. Among the weed management treatments, pyrazosulfuran-ethyl 15 g/ha as PE *fb* 2,4-D sodium salt 800 g/ha as PoE registered grain yield of 0.6 t/ha.

ANGRAU, Guntur

Among the weed management treatments, pyrazosufuron-ethyl 10 WP 15 g/ha as PE *fb* 2,4-D sodium salt 80 WP 0.80 kg/ha PoE at 20 DAS registered higher grain yield of 2.49 t/ha, which was at par with pyrazosufuron-ethyl 10 WP 15 g/ha PE *fb* metsulfuron-methyl + chlorimuron-ethyl at 4 g/ha at 20 DAS (2.29 t/ha). Maximum grain yield of 2.57 t/ha was obtained in 2 HW at 20 and 40 DAS **(Table1.1.6).**

Table 1.1.6 Effect of treatments on weed control efficiency, grain yield and BC ratio of drill sown finger millet

Weed Management	Weed control efficiency (%)			Grain yield (t/ha)	B: C
	20 DAS	40 DAS	Harvest		
Pyrazosulfuron-ethyl 10%WP 15 g/ha as PE	72.32	59.43	50.37	1.81	1.60
Atrazine 50%WP 0.5 kg/ha as PE	48.26	45.56	38.51	1.71	1.49
Pyrazosufuron-ethyl 10%WP 15 g/ha PE *fb* 2,4-D sodium salt 80% WP 0.80 kg/ha as PoE at 20 DAS	70.42	82.61	77.92	2.49	2.13
Atrazine 50%WP 0.5 kg/ha PE *fb* 2,4-D sodium salt 80% WP 0.80 kg/ha as PoE at 20 DAS	43.08	67.14	57.83	1.94	1.65
Pyrazosulfuron-ethyl 10%WP 15g/ha PE *fb* metsulfuron-methyl (10%) + chlorimuron-ethyl (10%) at 4 g/ha as PoE at 20 DAS	69.96	82.04	78.60	2.29	2.11
Atrazine 0.5 kg/ha PE *fb* metsulfuron methyl (10%) + chlorimuron-ethyl (10%) at 4 g/ha as PoE at 20 DAS	46.03	80.49	68.57	1.82	1.55
Weed free (hand weeding at 20 & 40 DAS)	35.01	85.55	82.01	2.57	1.85
Weedy check	72.32	59.43	50.37	1.16	1.04
SEm ±				0.09	
LSD (P=0.05)				0.28	

Weed Management in direct seeded/drill sown finger millet- a comparison of results at different centres

	UAS, Bengaluru	IGKVV, Raipur	PAJNCOA & RI, Puducherry	ANGRAU, Guntur
Promising weed management treatment	Atrazine 500 g/ha as PE *fb* metsulfuron-methyl + chlorimuron-ethyl 4 g/ha as PoE (20 DAS) recorded higher grain yield of 1.88 t/ha, higher net returns of Rs. 38,000/ha and BC ratio of 2.37.	Atrazine 500 g/ha as PE *fb* 2,4-D sodium salt 800 g/ha as PoE (20 DAS) recorded highest grain yield of 1.75 t/ha, net returns of Rs. 45,110/ha and BC ratio of 3.03.	Pyrazosulfuran-ethyl 15 g/ha as PE *fb* 2,4-D sodium salt 800 g/ha as PoE (20 DAS) registered grain yield of 602 kg/ha grain yield	Pyrazosufuron-ethyl 15 g/ha as PE *fb* 2,4-D sodium salt 80% WP 0.80 kg/ha PoE (20 DAS) registered higher grain yield of 2.49 t/ha, which was at par with pyrazosufuron-ethyl 15 g/ha PE *fb* metsulfuron-methyl (10%) + chlorimuron-ethyl (10%) at 4 g/ha at 20 DAS (2.29 t/ha)
Phyto-toxicity	Pyrazosulfuran-ethyl 15g/ha as PE and atrazine 500 g/ha as PE showed phyto-toxicity on crop by delaying the germination of ragi seeds up to 18 days after herbicide spray (DAHS). However, there was no phyto-toxic effect on new flushes of crop growth as seeds germinated fully after 25 days after herbicide spray.		In general, pyrazosulfuran-ethyl 15 g/ha as PE consistently exhibited minimal phyto-toxicity; howeve[r], atrazine 500 g/ha as PE consistently showed severe phyto-toxicity with the value of 10 at the phyto-toxicity rating scale of 0 to 10 on all observation days, indicating complete mortality of crop plants.	

WP-1.1.5. Weed management in soybean

Network Centres: UAS Bengaluru, BCKV Kalyani, PDKV Akola, CSKHPKV Palampur, MPUAT Udaipur, UAS Dharwad

Treatments:

Treatment	Dose	Time of application
Diclosulam	26 g/ha	PE
Pendimethalin + imazethapyr (RM)	800 g/ha	PE
Sulfentrazone + clomazone	725 g/ha	PE
Diclosulam + pendimethalin (TM)	25.2+750 g/ha	PE
Fluazifop-p-butyl + Fomesafen (RM)	250 g/ha	PoE (20 DAS)
Bentazone	960 g/ha	PoE (20 DAS)
Sodium acifluorfen + clodinafop propargyl	245 g/ha	PoE (20 DAS)
Imazethapyr + propaquizafop (RM)	125 g/ha	PoE (20 DAS)
2 HW at 20 and 40 DAS		
Weedy check		

UAS, Bengaluru

The major weeds found in association with the crops were *Cyperus rotundus* among sedge, *Eleusine indica* and *Digitaria marginata* among grasses and *Borreria hispida*, *Ageratum conyzoides*, *Commelina benghalensis*, *Celosia argentea*, *Oldenlandia corymbosa* and *Ionidium sulfruticosum* among broadleaf weeds. At all the stages of crop growth, the density of broadleaf weeds was higher than grasses and sedges.

The highest weed control efficiency at 20 DAS was observed in diclosulam 84 WDG + pendimethalin 38.7 CS (TM) (25.2 + 750 g/ha) (79.81%) followed by sulfentrazone 28+ clomazone 30 WP (RM) 725 g/ha (78.92 %). At 40 DAS and 60 DAS fluazifop -p- butyl 11.1 + fomesafen 11.1 SL 250 g/ha as PoE and sodium acifluorfen 16.5 + clodinafop-propargyl 8 EC 245 g/ha as PoE recorded the highest weed control efficiency of 70.0% and 70.95%, respectively. Among the chemical

weed management treatments, seed yield of soybean was significantly higher in sulfentrazone 28+ clomazone 30 WP (RM) 725 g/ha as PE (1.95 t/ha) followed by fluazifop -p- butyl 11.1 + fomesafen 11.1SL 250 g/ha as PoE (1.77 t/ha) and sodium acifluorfen 16.5 + clodinafop-propargyl l8 EC 245 g/ha (1.67 t/ha), these herbicide treatments were comparable with two hand weeding at 20 and 40 DAS (2.05 t/ha). The highest gross returns, net returns and BC ratio was obtained in sulfentrazone 28+ clomazone 30 WP (RM) 725 g/ha (Rs. 93,600/ha, Rs. 66,640/ha and 3.47, respectively) followed by fluazifop-p-butyl 11.1 +fomesafen 11.1 SL 250 g/ha (Rs. 84,960/ha, Rs. 60,040/ha and 3.41, respectively) and sodium acifluorfen 16.5 + clodinafop-propargyl 8 EC 245 g/ha as PoE (Rs. 80,160/ha, Rs. 54,725/ha and 3.15, respectively) **(Table 1.1.7).**

Among the weed management treatments, sulfentrazone 28+ clomazone 30WP (RM) 725 g/ha as PE, fluazifop-p-butyl 11.1 +fomesafen 11.1 SL 250 g/ha as PoE and sodium acifluorfen 16.5 + clodinafop-propargyl 8 EC 245 g/ha as PoE were recorded as effective weed management treatments for controlling weeds in soybean. These treatments were comparable with two hand weeding at 20 and 40 DAS.

Table 1.1.7 Effect of treatments on weed control efficiency, seed yield and economics of soybean

Treatments	WCE (%) at 40 DAS	Seed yield (t/ha)	Gross Returns (Rs./ha)	Net returns (Rs./ha)	BC Ratio
Diclosulam 84 WDG 26 g/ha as PE	19.37	1.28	61,440	37,320	2.55
Pendimethalin 30+ Imazethapyr 2 EC (RM) 800 g/ha as PE	34.01	1.45	69,600	44,380	2.76
Sulfentrazone 28+ Clomazone 30WP (RM) 725 g/ha as PE	54.73	1.95	93,600	66,640	3.47
Diclosulam 84WDG + Pendimethalin 38.7 CS (TM) (25.2 + 750 g/ha) as PE	38.74	1.32	63,360	38,160	2.51
Fluazifop-p-butyl 11.1+ Fomesafen 11.1 SL (RM) 250 g/ha as PoE (20 DAS)	68.47	1.77	84,960	60,040	3.41
Bentazone 48 SL 960 g/ha as PoE (20 DAS)	45.72	1.14	54,720	30,480	2.26
Sodium acifluorfen 16.5+ Clodinafop-propargyl 8 EC 245 g/ha as PoE (20 DAS)	70.95	1.67	80,160	54,725	3.15
Imazethapyr 3.75 + propaquizafop 2.5 ME (RM) 125 g/ha as PoE (20 DAS)	45.50	1.51	72,480	47,170	2.86
2 HW at 20 and 40 DAS	31.98	2.01	96,480	67,900	3.38
Weedy check	0.00	0.97	46,560	24,330	2.09
SEm±		0.23			
LSD (P=0.05)		0.70			

BCKV, Kalyani

Among the weed management treatments, imazethapyr + propaquizafop (RM) 125 g/ha PoE (20 DAS) was an effective treatment with higher yield (2.32 t/ha) and better economy (BC ratio of 2.01). The treatment pendimethalin + imazethapyr (RM) 800 g/ha as PE was recorded as the second best weed management treatment.

PDKV, Akola

Density of dicot weeds (64%) was much higher than that of monocot weeds (20%) throughout the crop growing season. Among the dicot weeds, the density values of *Euphorbia* sp., *Parthenium hysterophorus*, *Phyllanthus niruri, Alternanthera* spp., *Psoralea corylifolia, Celosia argentea, Lagasca mollis* and were higher than

monocot weeds *Commelina benghalensis*, *Cynodon dactylon, Dinebra retroflexa, Dactyloctenium aegyptium, Digitaria sanguinalis, Rottboelia cochinchinensis, Eleusine indica* and sedge *Cyperus rotundus* among sedges.

Among pre-emergence herbicides at 40 DAS, all the treatments were recorded statistically at par in reducing population of dicot weed. However, with respect to post-emergence herbicides, significantly lowest density of dicots weeds was recorded in imazethapyr 3.75 + propaquizafop 2.50 (RM) 125 g/ha as PoE (20 DAS) and found statistically at par with fluazifop-p-butyl 11.1+ fomesafen 11.1 (RM) 250 g/ha as PoE (20 DAS) and sodium aciflourfen 16.5 + clodinafop-propargyl 8EC 245 g/ha as PoE (20 DAS), whereas, bentazone was found ineffective in controlling dicot weeds. At 20, 40 and 60 DAS, application of sulfentrazone 28 + clomazone 30 WP (RM) 725 g/ha as PE recorded higher weed control efficiency over rest of the treatments. Among post-emergence herbicides application of imazethapyr + propaquizafop reported higher weed control efficiency over remaining post-emergence herbicidal treatments. Among the weed management treatments, application of sulfentrazone 28 + clomazone 30 WP (RM) 725 g/ha as PE, pendimethalin 30 EC + diclosulam 84 WDG (TM) (25.2 + 750 g/ha) as PE and diclosulam 84 WDG 26 g/ha as PE recorded higher seed yield over rest of the treatments, which in turn, was found at par with each other. The highest seed yield of 1.90 t/ha, highest net monetary returns of Rs. 50034/ha and BC ratio of 2.33 were registered by the sulfentrazone + clomazone, which was closely followed by treatment diclosulam.

For effective weed management and obtaining higher seed yield and economics of soybean, application of sulfentrazone 28% + clomazone 30% WP 725 g/ha (Ready-mix) as PE and diclosulam 84% WDG 26 g/ha as PE were found promising.

CSKHPKV, Palampur

The weed flora of the soybean experimental field during 2022 were *Cyperus* sp. (31%), *Polygonum alatum* (15%), *Digitaria sanguinalis* (10%), *Ageratum* sp. (11%) and *Commelina* sp. (8%). The other weeds as a whole constituted 25% of the total weed flora. During 2023, the major monocot weeds were *Digitaria sanguinalis* (8%), *Commelina* sp (8%), *Panicum dichotomiflorum* (6%), *Echinochloa colona* (6%), *Eleusine indica* (4%) and *Cyperus* sp. (16%). The major dicot weeds were *Bidens pilosa* (7%), *Polygonum alatum* (10%), *Ageratum* sp. (18%), *Euphorbia* sp. (4%), *Aeschynomene indica* (4%) and *Xanthium strumarium* (1%).

Fluazifop-p-butyl + fomesafen (RM) 250 g/ha as PoE (20 DAS) recorded 11.8% higher yield, 62.5% higher net returns due to weed control and more than 9.7 times higher MBCR over hand weeding twice during 2022. Sulfentrazone + clomazone (RM) 725 g/ha as PE recorded over 322 kg more yield during 2023.

All herbicide treatments were superior to hand weeding twice in increasing MBCR. Pendimethalin + imazethapyr (RM) 800 g/ha as PE recorded highest seed yield of 1.36 t/ha and highest net returns due to weed control of Rs. 58329/ha. Diclosulam 26 g/ha as PE had the highest MBCR followed by pendimethalin + imazethapyr (RM) 800 g/ha as PE, fluazifop-p-butyl + fomesafen (RM) 250 g/ha as PoE (20 DAS) and sodium-acifluorfen + clodinafop-propargyl (RM) 245 g/ha as PoE (20 DAS).

MPUAT, Udaipur

The dominant weed species were *Echinochloa colona* (47.02%), *Dinebra retroflexa* (13.18%), *Eleusine indica* (8.97%), *Digera arvensis* (7.40%), *Commelina benghalensis* (12.15%), *Physalis minima* (6.40%) and *Amaranthus viridis* (4.84%).

The maximum weed control efficiency at 40 DAS of total weed flora (98.17 %) and maximum seed yield of 1.75 t/ha were recorded with sulfentrazone + clomazone (RM) 725 g/ha as PE followed by 2HW at 20 and 40 DAS. Highest net returns of Rs. Rs. 79949/ha and BC ratio were recorded by the treatment sulfentrazone + clomazone 725 g/ha PE, which was at par with imazethapyr + propaquizafop (RM) 125 g/ha as PoE (20 DAS) (Seed yield of 1.66 t/ha, net returns of Rs. 76395/ha and BC ratio of 3.51).

The treatment sulfentrazone + clomazone (RM) 725 g/ha as PE was recorded as effective weed management treatment for controlling weeds, providing higher yields and net returns in soybean. Fluazifop-p-butyl + fomesafen (RM) 250 g/ha as PoE (20 DAS) showed phyto-toxicity on soybean plants.

UAS, Dharwad

The highest soybean yield was obtained from the treatment sodium acifluorfen + clodinafop-propargyl 245 g/ha as PoE (20 DAS) (3.45 t/ha), followed by fluazifop-p-butyl + fomesafen (RM) 250 g/ha as PoE (20 DAS) (Seed yield of 3.22 t/ha) and sulfentrazone + clomazone 725 g/ha as PE (Seed yield of 3.19 t/ha). Among the weed management treatments, sodium acifluorfen + clodinafop-propargyl 245 g/ha as PoE (20 DAS) has been recorded as an effective treatment for controlling weeds without phyto-toxicity on soybean plants.

Sodium-acifluorfen + clodinafop-propargyl 245 g/ha as PoE (20 DAS)

Weedy check

Weed management in soybean- a comparison of results at different centres

	UAS, Bengaluru	BCKV, Kalyani	PDKV, Akola	CSKHPKV, Palampur	MPUAT, Udaipur	UAS, Dharwad
Promising weed management treatment	Sulfentrazone + clomazone (RM) 725 g/ha as PE registered higher seed yield of 1.95 t/ha, net returns of Rs. 66,640/ha and BC ratio of 3.47.	Imazethapyr + propaquizafop (RM) 125 g/ha PoE (20 DAS) recorded higher seed yield of 2.32 t/ha and BC ratio of 2.01.	Sulfentrazone + clomazone (RM) 725 g/ha as PE recorded the highest seed yield of 1.90 t/ha, highest net returns of Rs. 50034/ha and BC ratio of 2.33.	Pendimethalin + imazethapyr (RM) 800 g/ha as PE recorded highest seed yield of 1.36 t/ha and highest net returns due to weed control of Rs. 58329/ha	Sulfentrazone + clomazone 725 g/ha PE recorded highest seed yield of 1.75 t/ha, highest net returns of Rs. 79949/ha and BC ratio of 3.66.	Sodium-acifluorfen + clodinafop-propargyl 245 g/ha as PoE (20 DAS) recorded highest seed yield of 3.45 t/ha.
Phyto-toxicity					4 to 3 scale of phytotoxicity was recorded at 10 to 20 days after herbicide application of fluazifop-p-butyl + fomesafen (RM) 250 g/ha PoE (20 DAS) as crop plants could not recover after some day	

WP-1.1.6. Weed management in transplanted onion

Network Centres: OUAT Bhubaneswar, BCKV Kalyani, PDKV Akola

Treatments:

Treatment	Dose	Time of application
Oxyfluorfen	100 g/ha	PE (0-5 DAT)
Quizalofop-ethyl	50 g/ha	PoE (20 DAT)
Oxyfluorfen *fb* Quizalofop-ethyl	100 g/ha *fb* 50 g/ha	PE (0-5 DAT) *fb* PoE (20-25 DAT)
Oxyfluorfen *fb* Quizalofop-ethyl + Oxyfluorfen (RM)	100 g/ha *fb* 100 g/ha	PE (0-5 DAT) *fb* PoE (20-25 DAT)
Oxyfluorfen *fb* Propaquizafop + Oxyfluorfen (RM)	100g/ha *fb* 148 g/ha	PE (0-5 DAT) *fb* PoE (20-25 DAT)
Oxyfluorfen *fb* Fluroxypyr meptyl	100 g/ha *fb* 360 g/ha	PE (0-5 DAT) *fb* PoE (20-25 DAT)
HW at 20, 40 & 60 DAT		
Weedy check		

OUAT, Bhubaneswar

Application of oxyfluorfen 50 g/ha as PE *fb* quizalofop–p-ethyl + oxyfluorfen (RM) 100 g/ha as PoE (25 DAT) recorded significantly highest onion yield of 23.4 t/ha. Highest net returns and BC ratio of Rs.85,426/ha and 2.62, respevtively, were obtained from weed-free treatment followed by application of oxyfluorfen 50 g/ha as PE *fb* quizalofop–p-ethyl + oxyfluorfen (RM) 100 g/ha as PoE (25 DAT) (Rs 71,523/ha as net returns and 2.59 as BC ratio). Among the weed management treatments, oxyfluorfen 50 g/ha as PE *fb* quizalofop–p-ethyl + oxyfluorfen (RM) 100 g/ha as PoE (25 DAT) has emerged as effective weed management treatment for controlling weeds and also providing higher yield and economic returns in onion.

BCKV, Kalyani

Oxyfluorfen 100 g/ha as PE (0-5 DAT) *fb* quizalofop-ethyl + oxyfluorfen (RM) 100 g/ha (25 DAT) has been found the best performing treatment with respect to better weed control, yield (23.5 t/ha) and economics (Net returns of Rs. 78,532/ha and BC ratio of 2.59) of onion crop grown during winter season.

PDKV, Akola

The major weed flora during *Kharif* season in the experimental field comprised by monocot *Cynodon dactylon, Cyperus rotundus, Commelina benghalensis, Ischaemum pilosum*, *Dinebra retroflexa* and dicot weeds *Digera arvensis, Euphorbia geniculata, Parthenium hysterophorus, Celosia argentea, Portulaca oleracea, Amaranthus viridis, Acalypha indica*, *Cardiospermum helicacabum*, *Ipomoea reniformis*, *Corchorus acutangulus, Phyllanthus niruri*, *Abelmoschus moschatus, Bidens pilosa*, *Boerhavia diffusa*, *Datura stramonium.*

Among the herbicidal treatments, higher weed control efficiency was recorded with sequential application of oxyfluorfen 100 g/ha as PE *fb* propaquizafop + oxyfluorfen 148 g/ha as PoE (20-25 DAT) followed by oxyfluorfen 100 g/ha as PE *fb* quizalofop-ethyl + oxyfluorfen 100 g/ha as PoE (20-25 DAT). However, lowest weed index was noticed with sequential application of oxyfluorfen 100 g/ha as PE *fb* propaquizafop + oxyfluorfen 148 g/ha as PoE (20-25 DAT) followed by oxyfluorfen 100 g/ha as PE *fb* quizalofop-ethyl + oxyfluorfen 100 g/ha as PoE (20-25 DAT). Higher weed index was recorded with herbicide treatment of quizalofop-ethyl 50 g/ha as PoE (20-25 DAT). Maximum bulb yield was recorded in hand weeding thrice at 20, 40 and 60 DAT followed by oxyfluorfen 100 g/ha as PE *fb* propaquizafop + oxyfluorfen (RM) 148 g/ha and oxyfluorfen 100 g/ha as PE *fb* quizalofop-ethyl + oxyfluorfen (RM) 100 g/ha as PoE (20-25 DAT), which were at par with each other.

Among the weed management treatments, oxyfluorfen 100 g/ha as PE *fb* propaquizafop + oxyfluorfen 148 g/ha as PoE (20-25 DAT) has been recorded as best weed management treatment for controlling weeds and obtaining higher onion bulb yield (17.20 t/ha), higher net returns (Rs. 42627/ha) and highest BC ratio (1.98) **(Table 1.1.8).**

Table 1.1.8. Effect of treatments on onion bulb yield and economics

Treatment	Onion bulb yield (t/ha)	Gross monetary returns (Rs./ha)	Net monetary returns (Rs./ha)	B:C
Oxyfluorfen 100 g/ha as PE	14.60	73000	31562	1.76
Quizalofop-ethyl 50 g/ha as PE	9.10	45500	3247	1.08
Oxyfluorfen 100 g/ha as PE *fb* quizalofop-ethyl 50 g/ha as PoE	14.80	74000	30962	1.72
Oxyfluorfen 100 g/ha as PE *fb* quizalofop-ethyl + oxyfluorfen (RM) 100 g/ha as PoE	16.40	82000	38117	1.87
Oxyfluorfen 100 g/ha as PE *fb* propaquizafop + oxyfluorfen (RM) 148 g/ha as PoE	17.20	86230	42627	1.98
Farmers practice (HW at 20, 40 and 60 DAT)	17.80	89230	42977	1.93
Weedy check	8.20	41230	977	1.02
SE (m) ±	0.22	2012	2012	--
LSD (P= 0.05)	0.68	6268	6268	--

Weed management in transplanted onion- a comparison of results at different centres

	OUAT, Bhubaneswar	BCKV, Kalyani	PDKV, Akola
Promising weed management treatment	Oxyfluorfen 50 g/ha as PE *fb* quizalofop–p-ethyl + oxyfluorfen (RM) 100 g/ha as PoE (25 DAT) recorded highest onion bulb yield of 23.4 t/ha, highest net returns of Rs. 71,523/ha and highest BC ratio of 2.59.	Oxyfluorfen 100 g/ha as PE (0-5 DAT) *fb* quizalofop-ethyl + oxyfluorfen (RM) 100 g/ha (25 DAT) recorded higher onion bulb yield of 23.5 t/ha and higher net returns of Rs. 78,532/ha and highest BC ratio of 2.59.	Oxyfluorfen 100 g/ha as PE *fb* propaquizafop + oxyfluorfen 148 g/ha as PoE (20-25 DAT) registered higher onion bulb yield of 17.20 t/ha, higher net returns of Rs. 42,627/ha and highest BC ratio of 1.98.

WP-1.1.7. Weed management in maize-chickpea cropping system

Network Centres: MPUAT Udaipur, RVSKVV Gwalior, PJTSAU Hyderabad, BCKV Kalyani, UAS Dharwad

Treatments:

Main-plot: Weed management in maize

M1: Atrazine + Tembotrione (TM) (750 +120) g/ha as EPoE (15 DAS)

M2: Atrazine + Topramezone (TM) (750 + 25.2) g/ha as EPoE (15 DAS)

M3: Atrazine + Mesotrione (RM) 875 g/ha as PoE (20 DAS)

M4: 2 HW at 20 DAS and 40 DAS

M5: Partially weedy (Weeds will be removed at 60 DAS after taking weed observations)

Sub-plot: Weed management in chickpea

S1: Topramezone 25.2 g/ha as PoE (20 DAS)

S2: Fluazifop-p-butyl + fomesafen (RM) 100 g/ha as PoE (20 DAS) *fb* HW at 40 DAS

S3: Pendimethalin + imazethapyr (RM) 750 g/ha as PE *fb* HW at 40 DAS

S4: 2HW at 20 and 40 DAS

S5: Partially weedy (Weeds will be removed at 60 DAS after taking weed observation)

MPUAT, Udaipur

Chickpea

The experimental plots of chickpea were infested with grassy, broadleaf weeds and sedges. The dominant weed species were *Phalaris minor* (6.09%), whereas the dicot weeds were *Chenopodium album* (30.43%), *Chenopodium murale* (15.52%), *Melilotus indica* (16.34%), and *Malwa parviflora* (17.97%), *Avena ludoviciana* (3.73%) and *Cyprus rotundus* (5.12%).

Among herbicidal treatments, the maximum weed control efficiency at 40 DAS of total weed flora (96.21%) was recorded with topramezone 25.2 g/ha as EPoE (20 DAS), which was followed by pendimethalin + imazethapyr (RM) 750 g/ha as PE *fb* HW at 40 DAS (84.71%) and fluazifop-p-butyl + fomesafen (RM) 100 g/ha as PoE (20 DAS) *fb* HW at 40 DAS (82.91%). Maximum seed yield of chickpea was recorded with topramezone 25.2 g/ha as PoE (20 DAS) (1.85 t /ha), which was followed by 2HW at 20 and 40 DAS (1.55 t/ha). The highest net returns of Rs. 78075/ha and BC ratio of 2.55 were recorded in topramezone 25.2 g/ha as PoE (20 DAS), which was followed by 2HW at 20 and 40 DAS with net returns of Rs. 56605/ha and BC ratio of 1.65**.**

Topramezone 25.2 g/ha as PoE (20 DAS) has emerged as best weed management treatment in chickpea. Mild discolouration of leaf chlorophyll and injury were observed in topramezone 25.2 g/ha and fluazifop-p-butyl + fomesafen (RM) treated chickpea plants and photo-toxicity symptom was recorded with the values of 2 and 1, respectively at 7 days after application of herbicides and chickpea plants were recovered with the progress of time.

Maize

The experimental plots were infested with grassy, broadleaf weeds and sedges. The dominant weed species were *Echinochloa colona* (54.26%), *Dinebra retroflexa* (5.48%), *Digera arvensis* (9.62%), *Commelina benghalensis* (4.48%), *Trianthema portulacastrum* (6.27%), *Eleusine indica* (8.33%) and *Physalis minima* (5.77%).

Among the herbicidal treatments, the maximum weed control efficiency at 40 DAS of total weed flora (100%) was recorded in atrazine + tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS), atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS). The maximum grain yield of maize was recorded with atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS) (4.47 t/ha), which was at par with atrazine + tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS) (4.03 t/ha). The highest value of net returns was recorded in atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS) (Rs. 88624/ha) closely followed by atrazine + tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS) (Rs. 77174/ha), while the maximum BC ratio was registered in atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS) (3.73) and it was followed by atrazine + tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS) (3.00).

Among the weed management treatments, atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS) and atrazine + tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS) were recorded as effective weed management treatments for controlling weeds in maize. Atrazine + tembotrione, atrazine + topramazone and atrazine + mesotrione showed mild phyto-toxicity symptoms on maize crop which recovered within a few days.

RVSKVV, Gwalior

Maize

During the experimentation, the weeds observed in the experimental site were *Echinochloa colona, Setaria glauca, Acrachne racemosa, Brachiaria reptans,* and *Cynodon dactylon* as narrow-leaved weeds, *Digera arvensis, Commelina benghalensis* and *Phyllanthus niruri* as broadleaf weeds and *Cyperus rotundus* as sedge. Out of 9 above species recorded in the maize only one major weed *Cyperus rotundus* was dominant during the entire growth period of maize.

At 20 and 40 DAS, the maximum weed control efficiency values (44% and 47%, respectively) were recorded in atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS). Whereas, at 60 DAS, the maximum weed control efficiency of 52.11% was registered in atrazine + tembotrione (Tank-mix) (750 +120) g/ha as EPoE. Maximum grain yield of 4.06 t/ha was achieved in 2HW at 20 and 40 DAS. Among all the herbicidal treatments, atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS) recorded highest grain yield of 3.34 t/ha followed by atrazine + mesotrione (RM) 875 g/ha as PoE (20 DAS). Maximum net returns of Rs.59775/ha and BC ratio of 2.97 were obtained in atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS) closely followed by atrazine + mesotrione (RM) (875) g/ha as PoE (20 DAS) (Net returns of Rs.57157/ha and BC ratio of 2.89).

Based on two-year experimentation, it has been concluded that among the weed management treatments, atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS) resulted in maximum control of grasses and provided maximum grain and stover yields with highest economic returns. This treatment was closely followed by the treatment atrazine + mesotrione (RM) 875 g/ha as PoE (20 DAS).

Atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS)

Partially weedy

Chickpea

The weeds observed in the experimental plots were *Phalaris minor, Spergula arvensis* and *Cynodon dactylon* as narrow-leaved weeds, *Chenopodium album, Anagallis arvensis, Medicago hispida* and *Rumex dentatus* as broadleaf weeds and *Cyperus rotundus* as sedge. Out of 7 above species recorded in the chickpea crop, only one major weed *Cyperus rotundus* was appeared as dominant weed during entire growing period of chickpea.

Among herbicidal treatments, at 40 and 60 DAS, the maximum weed control efficiency (31.22%) and (41.22%), respectively, was recorded in the treatments fluuazifop-p-butyl + fomesafen (RM) 100 g/ha as PoE (20 DAS) *fb* HW at 40 DAS, whereas at 20 DAS, the maximum weed control efficiency (47.64%) was observed in pendimethalin + imazethapyr (RM) 750 g/ha as PE *fb* HW at 40 DAS. Maximum seed yield of 1.81 t/ha was recorded in 2 HW at 20 & 40 DAS closely followed by pendimethalin + imazethapyr (RM) 750 g/ha as PE *fb* HW at 40 DAS (1.54 t/ha). Maximum net returns (Rs. 53205/ha) and BC ratio (2.53) were obtained in pendimethalin + imazethapyr (RM) 750 g/ha as PE *fb* HW at 40 DAS and this treatment resulted best among all the treatments in terms of production and profitability.

Among the weed management treatments, pendimethalin + imazethapyr (RM) 750 g/ha as PE *fb* HW at 40 DAS has appeared as best weed management treatment for controlling weeds and providing higher seed yield and highest economic returns in chickpea.

PJTSAU, Hyderabad

Chickpea

In maize-chickpea cropping system, at 40 DAS, lowest weed dry weight in chickpea was recorded in main plot treatment atrazine + mesotrione (RM) 875 g/ha as PoE (20 DAS), which was at par with atrazine + tembotrione (Tank-mix) 750+120 g/ha as EPoE (15 DAS) and 2 HW. Among sub-plot treatments, lowest weed dry weight was recorded in pendimethalin + imazethapyr 750 g/ha as PE *fb* HW at 40 DAS followed by topramezone 25.2 g/ha as PoE (20 DAS) *fb* HW at 40 DAS and fluazifop-p-butyl + fomesafen 100 g/ha as PoE (20 DAS) *fb* HW at 40 DAS. Among the combinations, lowest weed count was recorded in atrazine + mesotrione to maize and pendimethalin + imazethapyr (RM) 750 g/ha as PE *fb* HW at 40 DAS to chickpea. Higher seed yield of chickpea was recorded in 2 HW to maize; however, at par with atrazine + mesotrione among the main plot treatments. Among the sub-plot treatments, higher yield was recorded in pendimethalin + imazethapyr (RM) 750 g/ha as PE *fb* HW at 40 DAS followed by 2 HW to chickpea. The interaction effect was also significant. Highest seed yield of chickpea was recorded in 2 HW to maize and pendimethalin + imazethapyr (RM) 750 g/ha as PE *fb* HW at 40 DAS to chickpea, which was superior to rest of the treatment combinations. Among the treatment combinations, higher gross returns, net returns and BC ratio were recorded in atrazine + mesotrione (RM) 875 g/ha as PoE (20 DAS) to maize and pendimethalin + imazethapyr (RM) 750 g/ha as PE *fb* HW at 40 DAS to chickpea.

Among the weed management treatments in chickpea, pendimethalin + imazethapyr (RM) 750 g/ha

as PE *fb* HW at 40 DAS has been recorded as best weed management treatment for controlling weed and providing higher seed yield and highest economic returns in chickpea. Fluazifop-p-butyl + fomesafen (RM) 100 g/ha as PoE (20 DAS) shown phyto-toxicity on chickpea plants and the plants recovered gradually with the progress of time.

Maize

The weed flora observed during crop growing season consisted of *Cyperus rotundus*, *Trianthema portulacatrum, Alternanthera sessilis, Parthenium hysterophorus*, *Digera arvensis, Amaranthus viridis, Amaranthus polygamus, Aacalypha indica, Dactyloctenium aegyptium, Portulaca oleracea, Oldenlandia corymbosa, Ocimum tenuiflorum* and *Euphorbia geniculata* at various stages of crop growth.

The weed control efficiency at 20 DAS was higher with atrazine + tembotrione (Tank-mix) 750+120 g/ha as EPoE (15 DAS) followed by atrazine + topramezone (Tank-mix) 750+25.2 g/ha as EPoE (15 DAS). However, at 40 and 60 DAS, atrazine + mesotrione (RM) 875 g/ha as PoE (20 DAS) recorded higher weed control efficiency compared to the other herbicide treatments and was similar to hand weeding twice. Corresponding to the weed control, among the herbicidal treatments, significantly higher maize yield of 6.7 t/ha was recorded with atrazine + mesotrione (RM) 875 g/ha as PoE (20 DAS) and it was on par with hand weeding twice.

Based on the two-year experimental results, it can be concluded that atrazine + mesotrione (RM) 875 g/ha as PoE at 20 DAS was effective in controlling the weeds and also obtaining higher grain yield in *Kharif* maize. In maize-chickpea cropping system, the weed management treatments atrazine + mesotrione (RM) 875 g/ha as PoE at 20 DAS in maize and pendimethalin + imazethapyr (RM) 750 g/ha as PE *fb* HW at 40 DAS in chickpea have been recorded as effective weed management treatments.

BCKV, Kalyani

Chickpea

The experimental plots were infested with broadleaf weeds *Chenopodium album, Melilotus alba, Euphorbia hirta, Vicia sativa, Lathyrus aphaca,* and *Convolvulus arvensis,* sedge *Cyperus rotundus* and grasses *Cynodon dactylon,* and *Avena ludoviciana*.

Among the herbicidal treatments in chickpea, fluazifop-p-butyl + fomesafen (RM) 100 g/ha as PoE (20 DAS) *fb* HW at 40 DAS was found best in recording lowest weed density and dry weight of all types of weeds at all dates of observation taken. The next best performance was observed in pendimethalin + imazethapyr (RM) 750 g/ha as PE *fb* HW at 40 DAS. The treatment fluazifop-p-butyl + fomesafen (RM) 100 g/ha as PoE (20 DAS) *fb* HW at 40 DAS recorded highest weed control efficiency, seed yield (1.17 t/ha), stover yield (2.36 t/ha), highest net returns (Rs. 110143 /ha) and BC ratio (3.56) of chickpea.

Among the weed management treatments, fluazifop-p-butyl + fomesafen (RM) 100 g/ha as PoE (20 DAS) *fb* HW at 40 DAS has emerged as best weed management treatment for controlling weeds and obtaining higher seed yield and economic returns in chickpea.

Maize

Major weeds recorded in the experimental plots were *Cynodon dactylon, Eleusine indica* (grassy weed), *Cyperus rotundus* (sedge), *Argemone mexicana, Ageratum conyzoides, Euphorbia hirta, Trianthema portulacastrum* (broad-leaf weeds).

Among the herbicidal treatments, atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS) recorded the lowest weed density and weed dry weight and therefore, registered highest weed control efficiency of 79.13, 77.09 and 77.66% at 20, 40 and 60 DAS, respectively and was followed by the treatment atrazine + tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS). Atrazine + topramezone (TM) (750 + 25.2) g/ha as EPoE (15 DAS) maintained its superiority with highest grain yield of 7.72 t/ha, highest net returns of Rs.98248/ha and BC ratio of 2.56.

Based on the experimental results, it can be concluded that atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS) was effective in controlling the weeds in *Kharif* maize and recorded higher yields and economic returns. In maize-chickpea cropping system, the weed management treatments atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS) in maize and fluazifop-p-butyl + fomesafen (RM) 100 g/ha as PoE (20 DAS) *fb* HW at 40 DAS in chickpea have been recorded as effective weed management treatments.

UAS, Dharwad

Maize

Among the weed management treatments, atrazine + tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS) reduced the weed density as well as weed dry matter at 40 and 60 DAS (12.33 & 4.33 /m^2 and 6.84 and 1.24 g/m^2) and recorded highest grain yield of 5.5 t/ha, while atrazine + topramezone (Tank-mix) (750 +25.2) g/ha as EPoE (15 DAS) recorded the second highest grain yield of 5.52 t/ha.

Atrazine + tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS) has been recorded as best weed management treatment for controlling weeds in maize.

Atrazine + Tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS)

Atrazine + Topramezone (TM) (750 + 25.2) g/ha as EPoE (15 DAS)

Atrazine + Mesotrione (RM) 875 g/ha as PoE (20 DAS)

Partially weedy

Weed management in maize-chickpea cropping system- a comparison of results at different centres

	MPUAT, Udaipur	RVSKVV, Gwalior	PJTSAU, Hyderabad	BCKV, Kalyani	UAS, Dharwad
Promising weed management treatment	Maize: Atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS) recorded maximum grain yield of 4.47 t/ha, highest net returns of Rs. 88624/ha and highest BC ratio of 3.73.	Maize: Atrazine + topramezone (Tank-mix) (750 + 25.2) g/ha as EPoE (15 DAS) recorded highest grain yield of 3.34 t/ha, highest net returns of Rs.59775/ha and BC ratio of 2.97.	Maize: atrazine + mesotrione (RM) 875 g/ha as PoE (20 DAS) recorded highest grain yield of 6.75 t/ha.	Maize: Atrazine + topramezone (TM) (750 + 25.2) g/ha as EPoE (15 DAS) recorded highest grain yield of 7.72 t/ha, highest net returns of Rs.98248/ha and BC ratio of 2.56.	Maize: Atrazine + tembotrione (Tank-mix) (750 +120) g/ha as EPoE (15 DAS) recorded highest grain yield of 5.59 t/ha.
	Chickpea: Topramezone 25.2 g/ha as PoE (20 DAS) registered maximum seed yield of 1.85 t/ha, highest net returns of Rs. 78075/ha and BC ratio of 2.55.	Chickpea: Pendimethalin + imazethapyr (RM) 750 g/ha as PE *fb* HW at 40 DAS recorded higher seed yield of 1.54 t/ha, maximum net returns of Rs. 53205/ha and BC ratio of 2.53.	Chickpea: Pendimethalin + imazethapyr (RM) 750 g/ha as PE *fb* HW at 40 DAS recorded highest seed yield of 1.79 t/ha, highest net returns of Rs. 115887/ha and highest BC ratio of 2.22	Chickpea: Fluazifop-p-butyl + fomesafen (RM) 100 g/ha as PoE (20 DAS) *fb* HW at 40 DAS recorded highest seed yield of 1.17 t/ha, highest net returns of Rs. 110143 /ha and BC ratio of 3.56.	-
Phyto-toxicity	Maize: Atrazine + tembotrione, atrazine + topramazone and atrazine + mesotrione showed mild phyto-toxicity symptoms on maize crop; however, maize plants recovered after sometime.				
	Chickpea: Mild discolouration of leaf chlorophyll and injury were observed in topramezone 25.2 g/ha and fluazifop-p-butyl + fomesafen (RM) treated chickpea plants and photo-toxicity symptom was recorded with the values of 2 and 1, respectively at 7 days after application of herbicides and chickpea plants recovered with the progress of time		Chickpea: Fluuazifop-p-butyl + fomesafen (RM) 100 g/ha as PoE (20 DAS) shown phyto-toxicity on chickpea plants and the plants recovered gradually with the progress of time.		

Station Trials

ST-1.1.1. Long-term herbicide trial in transplanted lowland rice- blackgram cropping system

Centre: TNAU Coimbatore

Blackgram

Among the weed management treatments implemented in blackgram, clodinafop-propargyl + acifluorfen-sodium 185 g/ha as EPoE (15 DAS) recorded lower weed density and dry weight (2.07/m^2 and 1.29 g/m^2, respectively) at 20 DAS, higher weed control efficiency of 81.3% at 20 DAS, highest seed yield (817 kg/ha), highest net returns (Rs.52396/ha) and BC ratio (2.15).

Among the weed management treatments, clodinafop-propargyl + acifluorfen-sodium 185 g/ha as EPoE (15 DAS) has emerged as best weed management treatment for controlling weeds in blackgram under rice-blackgram cropping system.

Rice

At 20 DAT, the lowest weed density (3.34 /m^2), dry weight (2.15 g/m^2) and higher weed control efficiency of 82.9% were recorded in bensulfuron-methyl + pretilachlor 660 g/ha as PE *fb* bispyribac-sodium 25 g/ha as PoE and it was followed by pyrazosulfuron-ethyl 20 g/ha as PE *fb* penoxsulam + cyhalofop-butyl 135 g/ha as PoE. At 40 DAT and 60 DAT, the similar trend was observed with weed density, dry weight and weed control efficiency. Higher grain yield of 7.3 t/ha, higher net returns of Rs. 60220 and benefit cost ratio (2.24) were recorded in bensulfuron-methyl + pretilachlor 660 g/ha as PE *fb* bispyribac-sodium 25 g/ha as PoE closely followed by with pyrazosulfuron- ethyl 20 g/ha as PE *fb* penoxsulam + cyhalofop-butyl 135 g/ha as PoE (Grain yield of 7.1 t/ha, net returns of Rs. 56272 and benefit cost ratio of 2.13).

Among the weed management treatments, bensulfuron-methyl + pretilachlor 660 g/ha as PE *fb* bispyribac-sodium 25 g/ha as PoE has emerged as an effective weed management treatment for controlling weeds in transplanted rice. In case of rice-blackgram cropping system, treatment combination of bensulfuron-methyl + pretilachlor 660 g/ha as PE *fb* bispyribac-sodium 25 g/ha as PoE in transplanted rice and clodinafop-propargyl + acifluorfen sodium 185 g/ha as EPoE (15 DAS) in blackgram has been recorded as best weed management treatment for controlling weeds and obtaining higher yield and economic returns in this cropping system.

ST-1.1.4a. Management of blood grass (*Isachne miliacea)* in transplanted rice

Centre: KAU Thrissur

The *Isachne* infestation in unweeded control led to severe yield reduction (73% in location 1 and 82% in location 2) and the lowest net returns and BC ratio. Application of fenoxaprop-p-ethyl at the rate of 120 g/ha at 25-30 days after transplanting (DAT) can be recommended as an effective management practice of *Isachne miliacea* in transplanted rice. It is important to note that as the herbicide is applied at a higher dose, a delayed application at 25-30 DAT is recommended to avoid phyto-toxicity to the crop and also to have a sufficient spread of weed for the effective foliar action of the herbicide.

Isachne infested field at 30 days after transplanting

Isachne infested field at 2 weeks after spraying of fenoxaprop-p-ethyl 120 g/ha

ST-1.1.4b. Soil residue analysis of cyhalofop-butyl, penoxsulam, pendimethalin and butachlor in wetland rice fields

Centre: KAU, Thrissur

In case of ready-mix herbicides penoxsulam + pendimethalin, only pendimethalin was observed above detectable level after 2 hours and 10 days of spraying at 0.086 and 0.06 ppm, respectively. Residue levels of ready-mix herbicides penoxsulam + cyhalofop-butyl were below quantification levels at all the sampling intervals. Residues of butachlor persisted up to 30 days (0.036 ppm), which was longer than all the other herbicides.

ST-1.1.5. Management of alien weed *Syngonium podophyllum* in the rubber plantation

Centre: KAU, Thrissur

Removal by hand pulling or by mechanical methods using some simple hand tools is cumbersome and the plant parts discarded should be properly disposed of in deep pits or trenches to prevent regrowth. Herbicide 2, 4-D was found effective in controlling this weed. However total and long-lasting control could not be realized as the hardy portions of the stem/vine survived against the herbicidal action, which put forth the new growth over time. Also, spraying is not practical once the vines climb to greater heights on trees/supports. Making people aware of this problematic weed and ensuring community participation in eradication programmes through the integration of physical and chemical means can be recommended for the management of *Syngonium*.

Infestation of *Syngonium* in rubber plantation

Regrowth of *Syngonium* after brush cutting

30 days after spraying of 2,4-D

Regeneration after 60 days of spraying of metsulfuron-methyl + chlorimuron-ethyl

ST-1.1.6. Weed management in rajmash

Centre: CSHPKV, Palampur

Oxyfluorfen 150 g/ha as PE *fb* HW remaining at par with imazethapyr 75 g/ha as PE *fb* HW resulted in significantly higher yield of rajmash. Oxyfluorfen 150 g/ha as PE *fb* HW was recorded as most effective weed management treatment in rajmash for obtaining Rs 25,000/ha more net returns over hand weeding twice Farmer's practice.

ST-1.1.7. Weed management in pea

Centre: CSHPKV, Palampur

Pendimethalin + imazethapyr (RM) 750 g/ha as PE *fb* HW resulted in highest green pea yield (11.4 t/ha) and highest net returns due to weed control. It was followed by oxyfluorfen 150 g/ha as PE *fb* HW, pendimethalin + imazethapyr (RM) 800 g/ha as PE *fb* propaquizafop 50 g/ha as PoE and metribuzin 200 g/ha as PE *fb* HW.

ST-1.1.8. Weed management in cluster bean

Centre: MPUAT, Udaipur

Maximum seed yield of cluster bean was recorded in pyroxasulfone 85 WG 127 g./ha as PE (2.2 t/ha), which was at par with propaquizafop 2.5+ imazethapyr 3.75 w/w (RM) 125 g/ha at 2-3 leaf stage of weed (1.9 t/ha) and superior over the rest of the treatments. The highest value of net returns was recorded in pyroxasulfone 85WG 127 g/ha as PE (Rs. 103909/ha) closely followed by propaquizafop 2.5 + imazethapyr 3.75 w/w (RM) 125 g/ha at 2-3 leaf stage of weed (Rs. 99344/ha), whereas the highest BC ratio was registered in propaquizafop 2.5 + imazethapyr 3.75 w/w (RM) 125 g/ha at 2-3 leaf stage of weed (4.83) closely followed by pyroxasulfone 85 WG 127 g/ha as PE (4.27).

ST-1.1.9. Weed management in sesame

Centre: UAS, Bengaluru

Among the herbicidal treatments, pre-emergence application of alachlor 50 EC 1.0 kg/ha resulted in higher seed yield (414.4 kg/ha), which was at par with the pre-emergence application of pendimethalin 30 EC 0.75 kg/ha (409.4 kg/ha). The highest seed yield was obtained in two hand weeding at 20 and 40 DAS (523 kg /ha), which was significantly higher than the rest of the weed management practices. Highest value of net returns was recorded in hand weeding (20 and 40 DAS) (Rs. 70,152/ha) followed by alachlor 50 EC 1.0 kg/ha as PE (Rs. 56,197/ha), pendimethalin 30 EC 0.75 kg/ha PE (Rs. 55,983/ha) and inter-cultivation at 35 DAS *fb* hand weeding (Rs. 43,537/ha). Application of metribuzin 70 WP 0.30 kg/ha as PE and EPoE and diuron 80 WP 1.0 kg/ha (EPoE) had a severe phytotoxic effect on sesame plants; hence, the seed yield was not recorded.

ST-1.1.10. Weed management in groundnut

Centre: PDKV, Akola

Hoeing *fb* HW at 20 and 40 DAS recorded highest weed control efficiency from 20 DAS up to harvesting stage. Among the weed management treatments, maximum weed control efficiency at 40 DAS was recorded in treatment diclosulam 26 g/ha as PE *fb* propiquizafop + imazethapyr (RM) 125 g/ha as PoE (25 DAS) followed by diclosulam 26 g/ha as PE *fb* quizalofop-ethyl + imazethapyr (RM) 98 g/ha as PoE (25 DAS). Lowest weed control efficiency was observed in treatment sodium acifluorfen + clodinafop propargyl (RM) 245 g/ha as PoE (25 DAS) *fb* hoeing + HW at 40 DAS. Higher pod yield (2.62 t/ha), highest net returns (Rs. 113424/ha) and BC ratio (3.11) were recorded in pre-emergence application of pendimethalin + imazethapyr (RM) 800 g/ha as PE *fb* IC+HW at 40 DAS.

ST-1.1.11. Integrated weed management in cotton based inter cropping systems

Centre: PAJANCOA&RI, Puducherry

Results of the experiment revealed that cotton+ greengram intercropping system or sole cotton with herbicidal management of weeds (Pendimethalin 38.7 CS 640 g/ha as PE *fb* quizalofop ethyl 10 EC 45 g/ha as PoE at 25 DAS) resulted in higher seed cotton yield.

ST-1.1.12. Weed management in chickpea

Centre: AAU, Anand

Among the weed management treatments, topramezone 336 g/l w/v SC 20 g/ha as PoE *fb* HW at 40 DAS recorded maximum weed control efficiency of 95.7%, which was closely followed by pendimethalin 30+ imazethapyr 2 EC (RM) 480 g/ha as PE *fb* HW at 40 DAS (94.7%), topramezone 336 g/l w/v SC 15 g/ha as PoE *fb* HW at 40 DAS (94.7%) and pendimethalin 30EC 500 g/ha + oxyfluorfen 23.5 EC 120 g/ha as PE (TM) *fb* HW at 40 DAS (93.9%) at harvest. Significantly higher seed yield (3.84 t/ha), maximum gross returns (Rs. 211552/ha), net returns (Rs. 150258/ha) and BC ratio (3.45) were achieved in topramezone 336 g/l w/v SC 15 g/ha as PoE *fb* HW at 40 DAS.

ST-1.1.13. Integrated weed management in *Kharif* groundnut

Centre: AAU, Anand

Maximum weed control efficiency of 89.7% was observed under application of flumioxazin 50 SC 125 g/ha as PE *fb* IC + HW at 40 DAS; however, higher pod yield (4.2 t/ha), maximum net returns (Rs. 156466/ha)

and benefit cost ratio (2.71) were achieved under application of pendimethalin 30 + imazethapyr 2 EC (RM) 800 g/ha as PE *fb* IC + HW at 40 DAS.

ST-1.1.14. Effect of tillage and paddy residue management herbicides on weed management and productivity of mustard in a rice-mustard system.

Centre: PAU, Ludhiana

Rumex dentatus, *Medicago denticulata, Anagallis arvensis, Chenopodium album* and *Coronopus didymus* were the major weeds. Among tillage and residue management, ZT (+R) recorded significantly lower density of all weeds as well as weed biomass than CT (-R). ZT (+R) recorded significantly higher seed yield than CT (-R). Among weed control, pendimethalin and pyroxasulfone had lower weed density and biomass as compared to weedy check and higher doses of both herbicides provided better weed control than lower doses. ZT (+R) recorded significantly higher seed yield than CT (-R) under all weed control treatments. Combination of ZT (+R) with HW recorded highest seed yield (1.23 t/ha), which was at par to ZT (+R) combination with pendimethalin at 339 as well as 500 g/ha (Seed yield of 1.2 and 1.25 t/ha, respectively).

ST-1.1.15. Integrated weed management in peas

Centre: PAU, Ludhiana

The integrated use of pendimethalin 750 g/ha as pre-emergence followed by paddy straw mulch 7.5 t/ha resulted in highest pod yield (13.4 t/ha), which was statistically at par to post-emergence application of clodinafop + metribuzin (RM) 270 g/ha as PoE (13.1 t/ha). The lowest pod yield was observed in weedy check, which was at par with standalone application of pendimethalin 750 g/ha as pre-emergence.

ST-1.1.16. Efficacy of herbicides against diverse weed flora of barley

Centre: SKNAU, Jobner

Among the weed management treatments, highest weed control efficiency (88%) and maximum grain yield (4.98 t/ha) were recorded in pyroxasulfone + metsulfuron-methyl (TM) 127.5 + 4 g/ha as PoE, closely followed by pyroxasulfone 127.5 g/ha as PoE (Weed control efficiency of 80% and grain yield of 4.30 t/ha).

ST-1.1.17. Efficacy of herbicides against diverse weed flora of mustard

Centres: SKNAU Jobner, BUAT, Banda

SKNAU, Jobner

Results revealed that maximum seed & stover yield (2.6 and 5.9 t/ha, respectively) and minimum weeds were recorded in weed-free treatment, which were statistically at par with pre-emergence application of pendimethalin 750 g/ha *fb* 1 HW at 30-35 DAS (Seed yield of 25.5 and stover yield of 5.8 t/ha) and post-emergence application of quizalofop-ethyl 5 EC 40 g/ha at 30-35 DAS (Seed yield of 24.5 and stover yield of 5.6 t/ha). Highest degree of phyto-toxicity on mustard plants was observed in propaquizafop 5 + oxyfluofen 12 (RM) 43.75g + 105 g/ha as PoE treated plots.

BUAT, Banda

Pendimethalin 30 EC 750 g/ha as PE *fb* propaquizafop 5 + oxyfluorfen 12 w/w EC (RM) 43.75g + 105 g/ha as PoE significantly reduced the weed dry weight at most of the stages and recorded maximum weed control efficiency. Highest mustard seed yield (1.8 t/ha) was obtained in weed-free treatment, which was closely followed by pendimethalin 30 EC 750 g/ha as PE *fb* propaquizafop 5 + oxyfluorfen 12 w/w EC (RM) 43.75g + 105 g/ha as PoE (1.65 t/ha).

ST-1.1.18. Efficacy of new herbicides in managing broad spectrum weed flora in groundnut

Centre: SKNAU, Jobner

Results revealed that minimum weeds and maximum weed control efficiency were recorded in 2 HW, closely followed by sodium-acifluorfen 16.5 + clodinafop-propargyl 8 EC 245 g/ha at 2-3 leaf stage of weed. Maximum pod yield of 3.4 t/ha was recorded in 2 HW, which was found at par with sodium-acifluorfen 16.5 + clodinafop-propargyl 8 EC 245 g/ha at 2-3 leaf stage of weed (3.2 t/ha). Diclosulam 84 WDG 24 g/ha as PE and sulfentrazone 28 + clomozone 30 WP 725 g/ha as PE showed phyto-toxicity on groundnut plants.

ST-1.1.19. Weed management in greengram.

Centre: CCSHAU, Hisar

Sequential application of pendimethalin + imazethapyr 1000 g/ha (RM) as PE *fb* propaquizafop + imazethapyr (RM) 50 + 75 as PoE or pendimethalin + imazethapyr 1000 g/ha (RM) as PE *fb* fluazifop-p-butyl + fomesafen (RM) 250 g/ha as PoE recorded higher weed control efficiency than alone application of either as pre-emergence of post-emergence treatment. Weed-free treatment recorded higher seed yield (1.3 t/ha),

which was at par with pendimethalin + imazethapyr 1000 g/ha as PE *fb* propaquizafop + imazethapyr (RM) 50 + 75 as PoE (1.2 t/ha), pendimethalin + imazethapyr 937 +63 g/ha (TM) as PE *fb* propaquizafop + imazethapyr (RM) 50 + 75 as PoE and pendimethalin 1000 g/ha as PE *fb* propaquizafop + imazethapyr (RM) 50 + 75 as PoE. Highest net returns (Rs. 33041/ha) and higher BC ratio (1.47) were obtained with pendimethalin + imazethapyr 1000 g/ha as PE *fb* propaquizafop + imazethapyr (RM) 50 + 75 as PoE.

ST-1.1.20. Weed management in wet seeded *Kharif* rice.

Centre: AAU, Jorhat

The grain yield of wet seeded *Kharif* rice was significantly influenced by the weed management practices and highest grain yield (4.06 t/ha) was recorded in pretilachlor 750 g/ha as PE *fb* bispyribac-sodium 25 g/ha at 20-25 DAS, which remained at par with all the weed management practices.

ST 1.1.21. Evaluation of pre and post emergence herbicides in proso millet and kodo millet

Centre: ANGRAU, Guntur

Pre-emergence application of atrazine 750 g/ha has been found effective in controlling weeds without showing any phyto-toxicity on both the prosomillet and kodomillet crops. Application of butachlor 1.0 kg/ha and metolachlor 0.75 kg/ha registered significantly lower weed density and higher weed control efficiency; however, showed phyto-toxicity on both the crops. Germination of the crops was reduced by 60-65%. Among the post-emergence herbicides tested, bispyribac-sodium 25 g/ha was recorded effective in controlling weeds followed by 2,4-D sodium salt 0.80 kg/ha. Among the herbicides tested, the highest grain yield (787 kg/ha of prosomillet and 1.3 kg/ha of kodomillet) was registered in atrazine 0.75 kg/ha followed by bispyricbac- sodium 25 g/ha (778 kg/ha of prosomillet and 1.4 t/ha of kodomillet).

WP 1.2 Weed management under resource conservation techniques

WP 1.2.1 Weed management in rice-wheat-legume cropping system under conservation tillage

Network centers: GBPUAT Pantnagar, SKUAST Jammu and CCSHAU Hisar

Treatments:

Treatment	Rice (DSR)	Wheat	Greengram/green manure
Main plot	**Tillage**		
	CT	CT	CT
	CT+R	CT+R	CT+R
	ZT	ZT	ZT
	ZT+R	ZT+R	ZT+R
Sub plot	**Weed management**		
Herbicide rotation	1st year: Pendimethalin 678 g/ha (2 DAS) *fb* bispyribac -sodium 25 g/ha (20 DAS) 2nd year: Pretilachlor + pyrazosulfuron 615 g/ha (2 DAS) *fb* cyhalofop+ penoxsulam 135 g/ha (20 DAS) 3rd year: Pendimethalin+ pyrazosulfuron 920 g/ha (2 DAS) *fb* triafamone+ethoxysulfuron 66.5 g/ha (20 DAS)	1st year: Clodinafop + metsulfuron 64 g/ha (30 DAS) 2nd year: Mesosulfuron + iodosulfuron 14.4 g/ha (30 DAS) 3rd year: Pinoxaden + carfentrazone 40 + 20 g/ha or Sulfosulfuron + metsulfuron 32 g/ha (30 DAS)	1st year: Pendimethalin + imazethapy r 1.0 kg/ha (2 DAS) 2nd year: Imazethapyr 100 g/ha (20 DAS) 3rd year: Pendimethalin 678 g/ha (2 DAS)
IWM	Pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest	Clodinafop+ metsulfuron 64 g/ha (30 DAS) *fb* HW (45 DAS)	Pendimethalin 678 g/ha (2 DAS) *fb* hand weeding (30 DAS)
Unweeded check	Partially weedy (weeds removed after critical period)	Partially weedy (weeds removed after critical period)	Partially weedy (weeds removed after critical period)

DSR: direct-seeded rice; CT- Conventional tillage, ZT- Zero tillage, R- previous crop residue, *fb*- followed by

GBPUAT, Pantnagar

In *Rabi* 2022-23, major weeds under weedy situation were recorded as *Phalaris minor, Medicago denticulata, Melilotus indica, Chenopodium album, Solanum nigrum, Coronopus didymus* and *Rumex acetosella* at 30 DAS and *Phalaris minor, Medicago denticulata, Polygonum plebeium, Rumex acetosella* and *Solanum nigrum* at 60 DAS.

Density and biomass accumulation of all the weeds at 60 DAS were comparable among different tillage systems. In contrast, weed management practices had a significant effect on weed density of all the weeds except *Solanum nigrum* (Table 1.2.1). DSR(ZT+R)-wheat (ZT+R)-GM(ZT+R) recorded lower weed density of *Medicago denticulata* and *Polygonum plebeium* and completely controlled *Solanam nigrum*. The lowest density of *Rumex acetosella* was observed under DSR(ZT)-wheat (ZT)-GM(ZT), while biomass was lower in DSR(CT+R)-wheat (CT+R)-GM(CT+R). The lowest biomass of *Phalaris minor* was observed under DSR(CT)-wheat (CT)-GM(CT). Overall, DSR(CT+R)-wheat (CT+R)–GM(CT+R) recorded lower total weed density with the highest weed control (62.4%) while total biomass of all the weeds was lower under DSR(ZT+R)-wheat (ZT+R)-GM(ZT+R). The taller plant (101.4 cm), more number of spikes (429.1), higher grain (4.7 t/ha) and straw yield (6.7 t/ha) were obtained with DSR-(CT+R)-wheat (CT+R)-GM(CT+R). These helped in obtaining the highest net returns (Rs 110579.0/ha) under DSR(CT+R)-wheat (CT+R)-GM(CT+R) but the maximum B:C (3.79) was achieved under DSR(ZT+R)-wheat (ZT+R)-GM(ZT+R).

Among weed management practices, the lowest weed density and biomass of all the weeds with the highest WCE (95.7%) were recorded under clodinafop+ metsulfuron 64 g/ha (30 DAS) *fb* HW (45 DAS) which was significantly at par with clodinafop+ metsulfuron 64 g/ha (30 DAS). Further, the above weed management practices obtained the highest yield attributes and yield. The highest net returns (Rs. 118827/ha) and B: C (4.06) were recorded under clodinafop+ metsulfuron 64 g/ha (30 DAS) *fb* HW (45 DAS).

Table 1.2.1. Effect of establishment methods and weed management practices on weed control, growth, yield, and economics of wheat in rice-wheat-legume cropping system

Treatments	Total weed density (no./m^2)	Total weed biomass (g/ m^2)	WCE (%)	Grain yield (t/ha)	Straw yield (t/ha)	Net returns (Rs./ha)	B: C
Main plot - Tillage							
DSR(CT) - wheat (CT) - GM(CT)	2.3 (5.5)	8.0 (70.7)	61.0	4.3	6.6	101559	3.44
DSR(CT+R) - wheat(CT+ R)-GM(CT+R)	2.2 (5.3)	6.1 (44.9)	62.4	4.7	6.7	110579	3.59
DSR(ZT) -wheat (ZT) -GM(ZT)	2.2 (5.4)	5.7 (41.8)	61.7	4.3	6.2	103368	3.77
DSR(ZT+R) -wheat(ZT+R) - GM(ZT+R)	2.5 (7.5)	5.5 (34.2)	46.8	4.5	6.2	107232	3.79
SEm±	**0.4**	**0.8**	**-**	**0.1**	**0.1**		
LSD(p=0.5)	**NS**	**NS**	**-**	**NS**	**0.4**		
Sub plot - Weed management							
Clodinafop + metsulfuron 64 g/ha (30 DAS)	1.9 (3.0)	5.7 (34.7)	78.7	4.6	6.4	110486	3.82
Clodinafop+ metsulfuron 64 g/ha (30 DAS) *fb* HW (45 DAS)	1.3 (0.6)	4.0 (16.3)	95.7	4.8	7.1	118827	4.06
Partially weedy (wee ds removed after 60 DAS)	3.7 (14.1)	9.3 (92.7)	-	4.0	5.8	87741	3.07
SEm±	**0.2**	**0.5**	**-**	**0.1**	**0.2**		
LSD(p=0.5)	**0.6**	**1.6**	**-**	**0.4**	**0.5**		

During *Kharif* 2023, the major weed flora recorded under weedy situations were *Echinochloa colona, Alternanthera sessilis, Caesulia axillaris, Eclipta alba, Ammania baccifera, Mollugo pentaphyla, Portulaca oleracea* and *Cyperus iria* at 30 DAS and *Echinocloa colona, Echinochloa crus galli, Panicum maximum, Leptochloa chinensis, Alternanthera sessilis, Ammania baccifera, Caesulia axillaris, Cyperus iria, Cyperus rotundus, Cyperus difformis* and *Eleocharis quinqueflora* at 60 DAS.

At 60 DAS, among the establishment methods, lower weed density and biomass of *Echinocloa colona, Ammania baccifera, Cyperus iria* and complete control of *Cyperus difformis* were recorded under DSR(CT+R)-wheat(CT+R)-GM(CT+R) while DSR(ZT+R)-wheat(ZT+R)-GM(ZT+R) recorded lower density and biomass of *Echinocloa crus-galli.* The lowest weed density and biomass of *Panicum maximum* were recorded under DSR(ZT+R)-wheat-(CT+R)-GM(CT+R) and DSR(ZT)-wheat (ZT)-GM(ZT) (Table 1.2.2), whereas highest density and lowest biomass of *Leptochloa chinensis* was recorded under DSR(CT)-wheat (CT)-GM(CT). *Cyperus rotundus* was completely controlled by DSR(CT)-wheat (CT)-GM(CT) and DSR(ZT)-wheat (ZT)-GM(ZT). The lowest weed density and biomass of *Alternanthera sessilis* were recorded under DSR (CT+R)-wheat (CT+R)-GM (CT+R) and DSR(ZT+R)-wheat (ZT+R)-GM(ZT+R). DSR(CT)-wheat (CT)-GM(CT) and DSR(CT+R)-wheat (CT+R)-GM(CT+R), recorded the lowest weed density and biomass of *Caesulia axillaris.* The lowest weed density of *Eleocharis quinqueflora* was recorded under DSR (ZT)-wheat (ZT)-GM(ZT) and dry matter accumulation was recorded under DSR(CT)-wheat (CT)-GM(CT). Ultimately, DSR (CT+R)-wheat (CT+R)-GM(CT+R) recorded lower total weed density, biomass accumulation and highest weed control (67.7%). Yield attributing parameters were comparable except 1000 grain weight which was recorded with DSR(CT+R)-wheat (CT+R)-GM(CT+R).

Among the weed management practices, the lowest weed density and biomass of all the weeds were recorded under integrated weed management (IWM) i.e., pendimethalin 678 g/ha (2 DAS) *fb* bispyribac-sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest. This led to the lowest total weed density, biomass with the highest WCE (92.0%) resulted in better yield attributes under IWM but was at par with pretilachlor + pyrazosulfuron 615 g/ha (2 DAS) *fb* cyhalofop+ penoxsulam 135 g/ha (20 DAS). The combination of IWM with all different tillage methods resulted in highest grain yield and straw yield over other weed management. The highest net returns (Rs 51341.0/ha) and B: C (2.21) were recorded with DSR (ZT+R)-wheat (ZT+R)-GM(ZT+R) and IWM of Rs. 64727.0/ha and 2.39, respectively.

Table 1.2.2. Effect of establishment methods and weed management on weed control, yield and economics of rice under rice-wheat-legume cropping system

Treatments	Total weed density (no./m²)	Total weed biomass (g/m²)	WCE (%)	Grain yield (t/ha)	Straw yield (t/ha)	B: C
Tillage and residue management						
DSR(CT)-wheat (CT)-GM (CT)	7.9 (76.9)	9.5 (109.9)	55.5	3.2	5.6	1.99
DSR(CT+R)- wheat (CT+R)-GM(CT+R)	5.4 (37.3)	7.0 (79.9)	67.7	3.3	5.9	2.05
DSR(ZT)- wheat (ZT)-GM(ZT)	6.8 (53.3)	10.0 (114.3)	53.8	3.1	5.7	2.15
DSR(ZT+R) wheat (ZT+R) -GM(ZT+R)	6.4 (54.9)	9.8 (134.1)	45.8	3.3	5.8	2.21
SEm±	**0.33**	**0.32**	**-**	**0.2**	**0.4**	
LSD(p=0.5)	**1.17**	**1.13**	**-**	**NS**	**NS**	
Weed management						
Pendimethalin 678 g/ha (2 DAS) *fb* bispyribac-sodium 25 g/ha (20 DAS)	5.7 (32.8)	7.5 (61.8)	75.0	3.5	6.2	2.38
Pendimethalin 678 g/ha (2 DAS) *fb* bispyribac-sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest	3.3 (10.8)	4.1 (19.7)	92.0	3.9	7.0	2.39
Partially weedy (weeds removed after critical period)	11.0 (123.2)	15.7 (247.2)	-	2.2	4.1	1.53
SEm±	**0.40**	**0.53**	**-**	**0.2**	**0.2**	
LSD(p=0.5)	**1.21**	**1.61**	**-**	**0.5**	**0.7**	

DAS: days after sowing; HW- hand weeding; DSR: direct-seeded rice; ZT- zero tillage; GM- green manure; CT- conventional tillage; NS: non-significant

SKUAST, Jammu

In wheat during 2022-23, the study area comprised of weed flora such as *Phalaris minor*, *Rumex* spp., *Anagallis arvensis, Medicago denticulata* and *Rananculus arvensis,* and other weeds like *Vicia sativa* and *Melilotus indica.* Among the establishment methods, at 60 DAS, the lowest total weed density and biomass recorded in ZT+R followed by CT+R. The CT+R and ZT+R obtained almost similar yield attributes and yields of wheat. However, the highest net returns and B: C were observed in CT+R followed by ZT+R (**Table 1.2.3**).

At 60 DAS, among weed management practices, all weed management treatments recorded significantly lower weed density and weed biomass than the weedy check. The IWM (clodinafop + metsulfuron 64 g/ha at 30 DAS *fb* HW at 45 DAS) recorded significantly the lowest density and biomass of weeds as compared to the weedy check. All the weed management treatments recorded significantly higher growth, yield attributes and yields of wheat as compared to weedy check. Clodinafop + metsulfuron 64 g/ha (30 DAS) *fb* HW (45 DAS) gave a higher grain yield but it was found at par with clodinafop + metsulfuron 64 g/ha (30 DAS). However, B: C was higher in clodinafop + metsulfuron 64 g/ha (30 DAS).

Table 1.2.3. Effect of tillage and weed management practices on weed parameters at 60 DAS, yield and economics of wheat (*Rabi* 2022-23)

Treatments	Weed parameters at 60 DAS		Grain yield (t/ha)	Straw yield (t/ha)	Net returns (Rs./ha)	B: C
	Weed density	Weed biomass				
Tillage and residue management						
CT	6.73 (44.34)	9.03 (80.55)	4.06	5.32	57761	1.88
CT+R	6.04 (36.56)	8.24 (66.99)	4.14	5.47	64521	2.51
ZT	6.64 (43.12)	8.92 (78.68)	3.87	5.12	57547	2.16
ZT+R	5.68 (31.34)	7.68 (58.01)	4.05	5.38	60787	2.22
SEm ±	**0.04**	**0.03**	0.10	0.24	-	-
LSD (p=0.05)	**0.15**	**0.12**	**NS**	**NS**	-	-
Weed management						
HR: Clodinafop + metsulfuron 64 g/ha (30 DAS)	4.61 (20.34)	6.37 (39.58)	4.348	5.979	67714	2.54
IWM: Clodinafop + metsulfuron 64 g/ha (30 DAS) *fb* HW (45 DAS)	2.48 (5.17)	23.8(11.92)	4.57	6.30	68914	2.27
Unweeded check	9.59 (91.00)	12.75 (161.67)	3.17	3.70	43834	1.77
SEm ±	**0.04**	**0.05**	0.10	0.13	-	-
LSD (p=0.05)	**0.13**	**0.16**	0.30	0.38	-	-

Data were subjected to square root transformation √ X+1. Original values are in parenthesis

During *Kharif* 2023 in rice, the study area comprised of *Echinochloa* spp. and *Digitaria sanguinalis* amongst grassy weeds; *Caesulia axillaris* and *Physalis minima* amongst BLWs and *Cyperus rotundus* were only sedge present. Other weeds like *Commelina benghalensis, Alternanthera philoxeroides, Phyllanthus niruri* and *Cucumis* spp. were also recorded.

At 60 DAS, total weed density and biomass were significantly ($p<0.05$) influenced by tillage and residue management practices. The lowest total weed density and weed biomass were recorded in CT+R than other treatments. Growth parameters and yield attributes along with yield were non-significant, but a better response was recorded with CT+R followed by ZT+R. However, economic parameters like net returns and B: C were more with CT+R followed by ZT+R.

Among weed management practices, lower weed density and biomass were observed in IWM [pendimethalin 678 g/ha *fb* bispyribac-sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest] than herbicide alone and weedy check. Adoption of weed management practices enhances the growth parameters and yield attributes of rice resulting in higher grain and straw yield and economic returns. Imposition of IWM was recorded with the highest growth, yield and economic parameters followed by herbicides alone and the lowest with a weedy check **(Table 1.2.4)**.

Table 1.2.4. Effect of crop establishment methods and weed management on weeds, yield and economics on DSR (*Kharif* 2023)

Treatments	Total weed density at 60 DAS (no./m²)	Total weed dry weight at 60 DAS (g/m²)	Grain Yield (t/ha)	Straw yield (t/ha)	B: C
Tillage and residue management					
CT	8.54(71.89)	7.23(51.33)	3.17	4.16	3.31
CT+R	7.26(51.83)	6.07(35.85)	3.38	4.77	3.76
ZT	9.36(86.77)	9.81(95.26)	2.65	3.16	2.81
ZT+R	7.68(58.12)	6.96(47.4)	3.26	3.94	3.61
SEm ±	**0.17**	**0.33**	**0.40**	**0.59**	
L.S.D (p=0.05)	**0.33**	**0.48**	**NS**	**NS**	
Weed management					
HR: Pendimethalin 678 g/ha *fb* bispyribac-sodium 25 g/ha at 20 DAS	7.20(50.88)	7.71(58.39)	3.41	4.50	3.58
IWM: Pendimethalin 678 g/ha *fb* bispyribac-sodium 25 g/ha at 20 DAS *fb* HW at 40 DAS *fb* weed seed harvest	5.25(26.66)	3.95(14.59)	3.76	4.96	3.86
Unweeded check	11.17(123.92)	10.02(99.4)	2.18	2.56	2.53
SEm ±	**0.14**	**0.23**	**0.35**	**0.34**	
L.S.D(p=0.05)	**0.43**	**0.69**	**1.04**	**1.03**	

Data were subjected to square root transformation $\sqrt{X+1}$. Original values are in parenthesis

CCSHAU, Hisar

In wheat during 2022-23, significantly higher density of *P. minor* (23.8), *R. dentatus* (10.7), *M. denticulata* were recorded under CT conditions as compared to ZT+R with values 13.3, 4.9 and 12.7 no./m^2, respectively. The results showed that tillage and residue management failed to influence weed density and biomass of *P. minor*, *R. dentatus* and *M. denticulata*. However, numerically higher density and biomass of *P. minor* were observed under ZT conditions. However, significantly higher grain yield was recorded under ZT (5.1-5.3 t/ha) as compared to conventional tillage and conventional tillage with residue incorporation (4.8-5.0 t/ha). Higher crop lodging was recorded in CT and CT+RI (51-52.1

score) over ZT and ZT+R (1.9-3.6). Tillage and residue management did not influence growth and yield attributes. The grain and straw yield was higher with ZT+R (5.3 and 7.2 t/ha, respectively) followed by ZT (5.2 and 6.9 t/ha, respectively) **(Table 1.2.5)**. A higher lodging score was recorded under farmer practices (34.2) as compared to IWM (28.4) and HR (18.9) likewise taller plants were recorded in IWM (86 cm) as compared to herbicide rotation and farmers' practice. IWM recorded the highest grain and straw yield (5.4 and 7.2 t/ha, respectively) followed by farmers' practice (5.1 and 6.9 t/ha, respectively).

Table 1.2.5. Effect of tillage, rice residue and weed management practices on weeds, yield and yield attributes of wheat

Treatments	*Phalaris minor*		*Rumex dentatus*		*Medicago denticulata*		Grain yield (t/ha)	Straw yield (t/ha)	Lodging score
	(no./m²)	(g/m²)	(no./m²)	(g/m²)	(no./m²)	(g/m²)			
Tillage and residue management									
CT	2.1 (4.0)	1.8	2.7 (6.4)	1.1	2.8 (7.8)	1.0	5.02	7.01	52.1
CT+R	2.2 (4.7)	1.7	2.8 (7.6)	1.0	3.1 (9.3)	1.7	4.89	6.86	51.0
ZT+R	2.5 (5.8)	2.0	2.3 (4.9)	1.2	1.9 (3.1)	0.7	5.31	7.23	1.9
ZT	2.6 (6.9)	2.1	2.6 (6.0)	1.3	3.2 (10.2)	2.7	5.16	7.00	3.6
LSD(p=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	0.25	0.24	**10.3**
Weed management									
IWM	1.6 (2.0)	0.9	2.2 (4.2)	0.8	2.4 (5.3)	1.0	5.35	7.24	28.4
HR	3.1 (9.0)	2.9	2.9 (7.7)	1.4	2.9 (8.5)	1.9	4.86	6.89	18.9
FP	2.3 (5.0)	1.9	2.7 (6.8)	1.4	2.9 (9.0)	1.7	5.08	6.94	34.2
LSD(p=0.05)	**0.5**	**0.9**	**0.5**	**NS**	**NS**	**NS**	0.13	0.24	**9.2**

Soil compaction was more in ZT+R followed by ZT up to the 20 cm soil depth, further, there was not much difference among crop establishment methods (**Figure 1.2.1**).

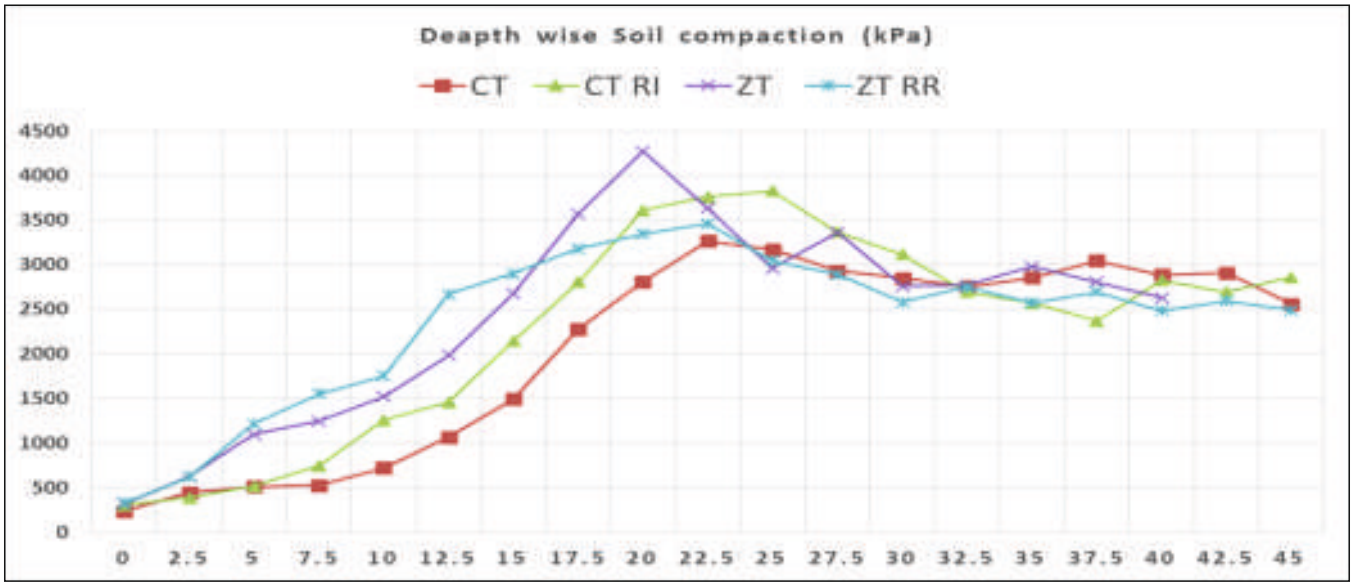


Fig. 1.2.1. Effect of tillage and residue management options in direct seeded rice-wheat-green gram on soil compaction after first crop cycle (*Rabi* 2022-23)

In rice during *Kharif* 2023, at 60 DAS, different tillage and residue management practices failed to affect the density of *E. crusgalli, D. aegyptium, C. rotundus* while density of *L. chinensis* and *A. baccifera* were found significantly higher under ZT as compared to CT/CT+RI conditions, but statistically at par with ZT+RR. At the same time, biomass of *D. aegyptium, L. chinensis, C. rotundus* and total biomass, except *E. crus-galli* and *A. baccifera* was influenced minimum of *E. crus-galli* under ZT+R, higher biomass of *D. aegyptium* under CT+R (20.84 g/m^2), while minimum in ZT +R (1.09 g/m^2). *L. chinensis* biomass was found significantly higher under ZT (13.31 g/m^2) followed by ZT+R (11.93 g/m^2) as compared to CT and CT+R (2.57-4.00 g/m^2). Total weed biomass was found significantly lower under CT (20.74 g/m^2) as compared to CT+R (40.98 g/m^2) and ZT (33.96 g/m^2), while statistical at par with ZT+RR (26.31 g/m^2) **(Table 1.2.6)**.

Among weed management practices, statistically similar results were found for *E. crusgalli*, *L. chinensis* for IWM (pendimethalin 38.5 CS formulation 678 g/ha) and farmer practices (FP) i.e. pendimethalin 30 EC 1000 g/ha (PE), as compared to pretilachlor + pyrazosulfuron 615 g/ha (PE). While, a significantly lower infestation of *C. rotundus* was recorded with herbicide rotation treatment. Among herbicide treatments, herbicide rotation comprised of pretilachlor + pyrazosulfuron 615 g/ha (PE) *fb* cyhalofop + penoxsulam 135 g/ha (20-25 DAS) has resulted in significantly higher density of *E. crus-galli* and *D. aegyptium* as compared to rest of the treatments. While, farmer practices (FP) of pendimethalin 30 EC 1000 g/ha *fb* bispyribac-sodium 25 mg/ha (PoE) resulted in significantly higher density of *L. chinensis* and *A. baccifera*, *C. rotundus* and total density, which was found statistically at par with HR for the same weeds. Weed management practices significantly affected the biomass of all prominent weeds. Maximum and significantly higher biomass of *E. crus-galli* (16.77), *D. aegyptium* (17.02) and total biomass (46.66) were recorded for the treatment HR as compared to IWM and FP. While, significantly higher biomass of *L. chinensis,* and *C. rotundus was* recorded for farmer practices. Higher grain yield and yield attributes were recorded in CT (main plot) and IWM in sub plots.

Table 1.2.6. Effect of tillage and weed control treatments on weed infestation, rice grain yield and yield attributes (*Kharif* 2022)

Treatments	Total weed parameters at 60 DAS		Grain yield (t/ha)
Main plot	Density (no./m^2)	Biomass (g/m^2)	
Tillage and residue management			
CT	5.3 (28.0)	20.74	3.5
CT+R	6.1 (37.5)	40.98	2.8
ZT+R	5.9 (36.0)	26.31	3.1
ZT	6.6 (45.8)	33.96	3.2
LSD(*P=0.05*)	0.7	11.02	3.4
Weedmanagement			
IWM	4.4 (18.7)	6.92	4.2
HR	6.7 (45.3)	46.66	2.1
FP	6.8 (46.5)	37.91	3.1
LSD(*P=0.05*)	0.8	6.11	.32

WP 1.2.2. Weed management in rice- maize-legume cropping system under conservation tillage

Network Centres: IGKV, Raipur and OUAT, Bhubaneshwar

Treatment	Rice (DSR)	Maize	Cowpea/greengram/green manure
Main plot	**Tillage and residue management**		
	CT	CT	CT
	CT+R	CT+R	CT+R
	ZT	ZT	ZT
	ZT+R	ZT+R	ZT+R

Table contd...

Sub plot	Weed management		
Herbicide rotation	1st year: Pendimethalin 678 g/ha (2 DAS) *fb* bispyribac-sodium 25 g/ha (20 DAS) 2nd year: Pretilachlor + pyrazosulfuron 615 g/ha (2 DAS) *fb* cyhalofop+ penoxsulam 135 g/ha (20 DAS) 3rd year: Pendimethalin+pyrazosulfuron 920 g/ha (2 DAS) *fb* triafamone+ethoxysulfuron 66.5 g/ha (20 DAS)	1st year: Atrazine 1.0 kg/ha (2 DAS) *fb* topramezone 25.2 g/ha (20 DAS) 2nd year: Pyroxasulfone 127.5 g/ha (2 DAS) *fb* tembotrione 120 g/ha (20 DAS) 3rd year: Atrazine + mesotrione 875 g/ha (20 DAS)	1st year: Pendimethalin + imazethapyr 1.0 kg/ha (2 DAS) 2nd year: Imazethapyr 100 g/ha (20 DAS) 3rd year: Pendimethalin 678 g/ha (2 DAS)
IWM	Pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest	Atrazine 1.0 kg/ha (2 DAS) *fb* topramezone 25.2 g/ha (20 DAS)) *fb* hand weeding (40 DAS) *fb* weed seed harvest	Pendimethalin 678 g/ha (2 DAS) *fb* hand weeding (30 DAS)
Unweeded check	Partially weedy (weeds removed after critical period)	Partially weedy (weeds removed after critical period)	Partially weedy (weeds removed after critical period)

IGKV, Raipur

In maize during 2022-23, the experimental field was heavily infested with *Medicago denticulata*, *Echinochloa colona*, *Chenopodium album* and *Convolvulus arvensis* with a dominance of *Medicago denticulata* having almost 33% of the total population. At 60 DAS, a lesser number of weeds were observed under ZT+R-ZT+R- ZT+R followed by CT+R-CT+R-CT+R as compared to the same tillage practice without residue incorporation. Growth and yield attributes were recorded higher in ZT+R. Significantly higher grain yield (4.85 t/ha) with a maximum net return of Rs.56053/ha and B: C (2.39) was recorded under the ZT+R-ZT+R-ZT+R. However, CT+R-CT+R-CT+R also produced a comparable grain yield (4.76 t/ha) to that of ZT+R.

Results also revealed that among weed management practices, lesser number of weeds with better growth and yield attributes of maize were recorded under IWM [atrazine 1.0 kg/ha (2 DAS) *fb* topramezone 25.2 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest] at all the observational stages. Almost similar findings were recorded in the case of weed biomass at all stages. Significantly higher values of yield attributes, grain yield (6.01 t/ha) and net returns were recorded in IWM option as compared to recommended and partially weedy (weeds removed after critical period) treatment **(Table 1.2.7)**.

Table 1.2.7. Weed biomass, grain yield and economics as influenced by crop establishment methods and weed management practices in wheat in *Rabi* 2021-22

Treatments	Weed biomass (g/m^2)	Grain yield (t/ha)	Net returns (Rs./ha)	B: C
Tillage and residue management				
CT -CT-CT	7.39(54.16)	4.06	34788	1.76
CT-R-CT+R-CT+R	5.38(28.43)	4.76	49765	2.10
ZT -ZT-ZT	6.70(44.40)	4.33	50406	2.29
ZT-R-ZT+R-ZT+R	4.94(23.94)	4.85	56053	2.39
SEm±	**0.50**	**0.04**	-	-
LSD (P= 0.05)	**1.75**	**0.16**	-	-
Weed management				
Recommended (Atrazine 1.0 kg/ha *fb* topramezone 25.2 g/ha)	5.73(32.33)	5.09	59271	2.46
Integrated (Atrazine 1.0 kg/ha *fb* topramezone 25.2 g/ha *fb* hand weeding 40 DAS)	3.73(13.39)	6.01	72184	2.59
Partially weedy (weeds removed after critical period)	8.24(67.48)	2.40	9443	1.35
SEm±	**0.32**	**0.03**	-	-
LSD (P= 0.05)	**0.96**	**0.10**		

*Original values are given in parenthesis, which were transformed to $\sqrt{x+1}$

In cowpea during summer 2023, the experimental field was dominated by *Echinochloa colona*, *Alternanthera triandra, Cynodon dactylon* with a dominance of *Echinochloa colona* having 48% of total population in partially weedy. At 40 DAS, fewer density of weeds was observed under those plots with ZT+R-ZT+R-ZT+R and followed by CT+R-CT+R-CT+R as compared to the same tillage and residue management. These might be due to a continuous layer of crop residues between rows resulting in suppression of emerging weeds. Significantly higher fodder yield (27.83 t/ha) and net returns and B: C were obtained under ZT(DSR)+R-ZT+R–ZT+R followed by ZT(DSR)-ZT+R-ZT **(Table 1.2.8).**

Among weed management practices, the lowest weed density and biomass were observed under IWM i.e. Pendimethalin 678 g/ha *fb* hand weeding. Almost similar findings were recorded in the case of weed biomass at all stages. Adoption of IWM achieved maximum green fodder yield (31.81 t/ha), net returns and B: Cover the rest of the treatments. The lowest green fodder yield, net returns, and B: C were obtained under weedy check.

Table 1.2.8. Weed biomass, plant height at 40 DAS, green fodder yield, net returns and B: C of cowpea as influenced by crop establishment methods and weed management during summer 2022

Treatments	Weed biomass (g/m^2)	Plant height (cm)	Green fodder yield (t/ha)	Net returns (Rs. /ha)	B: C
Tillage and residue management					
CT-CT-CT	6.86(46.56)	42.11	23.66	10433	1.32
CT+R-CT+R-CT+R	5.88(34.03)	44.88	26.78	22966	1.67
ZT-ZT-ZT	6.56(42.49)	44.10	20.28	18055	1.66
ZT+R-ZT+R-ZT+R	5.45(29.24)	45.84	27.83	55667	1.85
SEm±	**0.10**	**0.87**	**0.60**	**-**	**--**
LSD (P= 0.05)	**0.34**	**3.02**	**2.08**	**-**	**-**
Weed management					
Pendimethalin +imazethapyr 1.0 kg/ha	6.21(38.05)	43.53	29.03	25549	1.67
Pendimethalin 678 g/ha *fb* hand weeding	3.93(14.93)	48.77	31.81	40674	1.79
Unweeded check	7.86(61.26)	40.40	13.07	14116	1.41
SEm±	**0.09**	**0.68**	**0.65**	**-**	**-**
LSD (P= 0.05)	**0.30**	**2.05**	**1.95**	**-**	**-**
Interaction T x W	NS	NS	NS		

In rice during 2023, the experimental field was comprised of *Echinochloa colona* among grasses, *Cyperus iria* among sedges and *Alternanthera triandra* among broadleaf weeds. Broadleaf weeds and sedges dominated the weed flora at all the growth stages as compared to grasses and other weeds. Other weeds like *Brachiaria ramosa*, *Sporobolus diander*, *Cyanotis axillaris, Commelina benghalensis, Ludwigia parviflora* etc. were also found in irregular and less number. *Cyanotis axillaris* and *Sporobolus diander* being late *Kharif* weeds dominated the weed flora during maturity of the crop.

Weed density and biomass recorded at 30, 60 DAS and at harvest revealed that tillage practices caused remarkable variation at all the stages of crop growth. The lowest weed density and biomass were found under CT+R-CT+R-CT+R over CT-CT-CT, ZT-ZT-ZT, and over ZT+R-ZT+R-ZT+R at all stages. However, weed density and biomass were lower in ZT(DSR)+R as compared to ZT alone, this might be due to the presence of crop residues. The highest effective tillers and grain yield of rice were measured under CT over ZT. CT+R produced the highest grain yield of 5.31 t/ha, net returns (Rs. 82821/ha) over CT. Likewise, ZT+R produced a little higher yield over ZT **(Table 1.2.9)**.

As regards of weed management, the lower density of total weeds and biomass was less under IWM followed by RH over control. IWM [pendimethalin 678 g/ha (2 DAS) *fb* bispyribac-sodium 25 g/ha (20 DAS) with hand weeding (40 DAS) *fb* weed seed harvest] produced significantly the highest grain yield (5.96 t/ha) over RH [Pretilachlor + pyrazosulfuron 615 g/ha (2 DAS) *fb* penoxsulam + cyhalofop 135 g/ha (20 DAS)] (5.74 t/ha). Partially weeded plots produced the lowest yield of rice. IWM also generated the highest net returns (Rs. 90424/ha) while the RH fetched the highest B: C (4.07) over the rest of the two practices.

Table 1.2.9. Weed biomass, yield and economics of rice as influenced by crop establishment methods and weed management practices in rice, *Kharif* 2023

Treatments	Weed biomass (g/m^2) at 60 DAS	Test weight (g)	Grain yield (t/ha)	Net returns (Rs./ha)	B: C
Tillage and residue management					
CT-CT-CT	6.80(45.70)	29.35	4.84	73725	3.28
CT+R-CT+R-CT+R	6.59(42.98)	28.64	5.31	82821	3.43
ZT-ZT-ZT	7.18(51.11)	28.90	4.27	65642	3.36
ZT+R-ZT+R- ZT+R	7.01(49.82)	29.58	4.73	72811	3.37
SEm±	**0.02**	**0.52**	**0.08**	-	-
LSD (P= 0.05)	**0.05**	**NS**	**0.26**	-	-
Weed management					
Recommended [Pretilachlor + pyrazosulfuron 615 g/ha (2 DAS) *fb* penoxsulam + cyhalofop 135 g/ha (20 DAS)]	5.00(24.47)	29.91	5.78	94594	4.01
Integrated weed management [Pendimethalin 678 g/ha (2 DAS) *fb* bispyribac-sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest]	4.21(17.22)	30.41	5.96	98105	4.07
Partially weedy (weeds removed after critical period)	10.05(100.55)	27.05	2.63	28550	2.00
SEm±	**0.04**	**0.67**	**0.09**	-	-
LSD (P= 0.05)	**0.11**	**1.97**	**0.27**	-	-

OUAT, Bhubaneswar

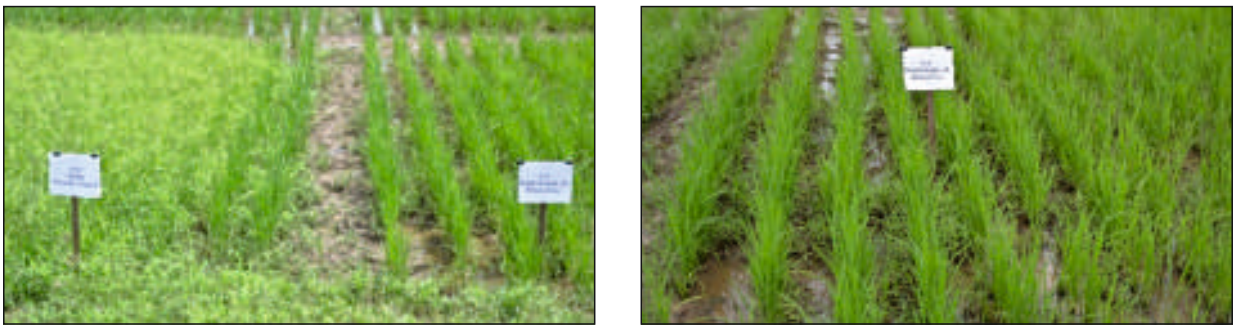
In rice during 2023, the floristic composition of the experimental site during the season was dominated by grasses (55%) followed by BLWs (30%) and sedges (15%). The trend observed in different categories of weeds from the year of initiation of the experiment was *Panicum repens* (21%), *Echinochloa crusgalli* (17%) and *Echinochloa colona* (14%) were observed to be the dominant grasses. *Marselia quadrifolia* (18 %) and *Alternanthera sessilis* (27%) were the major BLWs. *Cyperus difformis* (12%) and *Cyperus iria* (3%) were the important sedges observed in the experimental site. Other minor weeds observed were *Ludwigia parviflora, Leptochloa chinensis, Cyperus rotundus, Paspalum scrobiculatum* and *Dactyloctenium aegyptium*. The CT method of tillage recorded significantly the lowest weed density at 60 DAS over ZT methods. The average weed biomass (39.92 g/m^2) in ZT was found to be 35 % more than the weed biomass (24.84 g/m^2) found in the CT plots. The highest grain yield was obtained in the CT+R-CT+R-CT+R system (4.28 t/ha) as compared to CT-CT-CT (3.84 t/ha) which is also significantly superior to ZT-ZT-ZT system. The lowest yield was recorded with ZT-ZT-ZT system (1.94 t/ha). Similarly, the economics was followed in a similar trend by obtaining the highest B: C (1.98) with the lowest (1.75) **(Table 1.2.10)**.

The recommended practice pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) at 1st year significantly lowered the weed densities (41/m^2) over the unweedy check (115/m^2) at 60 DAS and the decrease was in the tune of 57%. Imposition of IWM [pndimethalin 678 g/ha (2 DAS) *fb* bispyribac-sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest] reduced the weed population significantly (64%) over unweedy check.

Integration of the CT method and IWM obtained the maximum B: C in the *Kharif* rice. The composition of the weed seed bank in the ZT system was dominated by grasses (54%) followed by BLWs (26%) and sedges (20%) and the corresponding values in the CT system were 48%, 35% and 17%, respectively.

Table 1.2.10. Effect of crop establishment methods and weed management practices on weed parameters at 60 DAS, yield and economic parameters of rice

Treatments	Total weed density (no./m^2)	Total weed biomass (g/m^2)	Yield (t/ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C
Tillage and residue management						
CT-CT-CT	9.66 (93.7)	5.48 (30.6)	3.84	49380	16280	1.90
CT+R-CT+R-CT+R	8.42 (70.8)	4.35 (18.9)	4.28	49210	18390	1.98
ZT-ZT-ZT	11.51 (132.2)	6.82 (46.8)	1.94	42520	11285	1.82
ZT+R-ZT+R-ZT+R	9.64 (93.4)	4.54 (20.6)	2.32	43280	10800	1.75
LSD (P=0.05)	2.28	1.78	1.24	-	-	-
Weed management						
Recommended herbicides with rotation	8.33 (69.3)	5.68 (32.8)	3.94	52250	15800	2.30
IWM	5.58 (31.7)	4.27 (18.6)	4.52	54400	17890	1.95
Partial weed check	14.00 (196.4)	7.77 (60.8)	2.34	35840	3750	0.72
LSD (P=0.05)	2.93	1.25	0.84	-	-	-



CT with partially weedy VS application of pendimethalin *fb* bispyribac at 30 DAS

WP 1.2.3. Weed management under conservation tillage system on maize-based cropping system

Network Centres: UAS Bengaluru, PAU Ludhiana, CCSHAU Hisar, RVSKVV Gwalior

Treatment	Maize	Mustard	Greengram	Green manure
Main plot	*Tillage and residue management*			
	CT CT+R ZT ZT+R	CT CT+R ZT ZT+R	CT CT+R ZT ZT+R	CT CT+R ZT ZT+R
Sub plot	***Weed management***			
Herbicide rotation	1st year: Atrazine 1.0 kg/ha (2 DAS) *fb* topramezone 25.2 g/ha (20 DAS) 2nd year: Pyroxasulfone 127.5 g/ha (2 DAS) *fb* tembotrione 120 g/ha (20 DAS) 3rd year: Atrazine + mesotrione 875 g/ha (20 DAS)	1st year: Pendimethalin 339 g/ha (2 DAS) *fb* pinoxaden 50 g/ha (after first irrigation) 2nd year: Pendimethalin 339 g/ha (2 DAS) *fb* fenoxaprop 100 g/ha (after first irrigation) 3rd year: Oxadiargyl 90 g/ha (2 DAS) *fb* clodinafop 60 g/ha (after first irrigation)	1st year: Pendimethalin + imazethapyr 1.0 kg/ha (2 DAS) 2nd year: Imazethapyr 100 g/ha (20 DAS) 3rd year: Pendimethalin 678 g/ha (2 DAS)	-
IWM	Atrazine 1.0 kg/ha (2 DAS) *fb* topramezone 25.2 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest	Pendimethalin 339 g/ha (2 DAS) *fb* hand weeding (30 DAS) *fb* WSH	Pendimethalin 678 g/ha (2 DAS) *fb* hand weeding (30 DAS)	-
Unweeded check	Partially weedy (weeds removed after critical period)	Partially weedy (weeds removed after critical period)	Partially weedy (weeds removed after critical period)	Partially weedy (weeds removed after critical period)

UAS, Bengaluru

In *Rabi* greengram (2022-23), the major weed flora observed in the experimental plots was *Cyperus rotundus* (among sedges), *Eleusine indica*, *Digitaria marginata, Dactyloctenium aegyptium* (among grasses). Whereas, *Borreria hispida, Ageratum conyzoides, Commelina benghalensis, Emilia sonchifolia, Acanthospermum hispidum Lonaidium sulfruiticesum, Celosia argentea* and *Amaranthus viridis* were major broadleaf weeds. Grasses were the dominant weed flora followed by BLWs and sedges.

At 60 DAS, CT+R obtained the lowest density and biomass (20.22 no./m^2) followed by CT (22.78 no./m^2). Between the ZT and CT practices, ZT recorded the lowest weed density at all stages of crop growth. The lowest weed biomass was obtained with ZT+R (28.2 g/m^2) followed by ZT (38.48 g/m^2) over CT and CT+R. Contrarily, CT+R recorded a higher seed yield (0.75 t/ha) followed by CT (0.72 t/ha). Gross returns were higher with CT+R (Rs. 61200/ha), while net returns and B: C was higher with ZT (Rs. 35,030/ha and 2.38, respectively) **(Table 1.2.11)**.

Among the weed management practices, at 60 DAS, application of pendimethalin + imazethapyr 1.00 kg/ha (2 DAS) (22.58 no./m^2) followed by pendimethalin 678 kg/ha (2 DAS) *fb* HW (30 DAS) (24.00 no./m^2) recorded lower weed density. Partially weedy check recorded the highest weed density (30.00 no./m^2). While weed biomass was lowest with pendimethalin 678 kg/ha (2 DAS) *fb* HW (30 DAS) (21.76 g/m^2) with higher seed yield (0.78 t/ha) and gross returns (Rs. 66300/ha) followed by pendimethalin + imazethapyr 1.00 kg/ha (2 DAS). However, pendimethalin + imazethapyr 1.00 kg/ha (2 DAS) recorded the highest net returns and B: C (Rs. 36,180/ha and 2.24, respectively).

Table 1.2.11. Effect of crop establishment methods and weed management practices on weed parameters, yield, and economics in greengram, *Rabi* 2022-23

Treatments	Total weed density (no./m²)	Total weed biomass (g/m²)	Greengram yield and economics (Rs/ha)					
			Seed yield (t/ha)	Weed index (%)	CoC (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B: C
Tillage and residue management								
CT	4.79(22.78)	6.72(49.54)	0.72	--	28,260	61,200	32,940	2.17
CT + R	4.54(20.22)	6.43(44.45)	0.75	--	29,450	63,750	34,300	2.16
ZT	5.33(28.44)	5.98(38.48)	0.71	--	25,320	60,350	35,030	2.38
ZT+ R	5.58(30.67)	5.19(28.20)	0.69	--	26,280	58,650	32,370	2.23
SEm ±	0.20	0.73	0.01	NA	NA	NA	NA	NA
LSD (P=0.05)	0.70	2.53	0.03					
Weed management								
W_1	4.81(22.58)	3.87(23.40)	0.77	1.28	29,270	65,450	36,180	2.24
W_2	5.14(24.00)	3.58(21.76)	0.78	0.00	31,260	66,300	35,040	2.12
W_3	5.22(30.00)	3.56(25.17)	0.67	14.10	25,940	56,950	31,010	2.20
SEm±	0.07	0.52	0.01	NA	NA	NA	NA	NA
LSD (P=0.05)	0.21	1.55	0.03					

NS – Non-Significant. * Data in the parenthesis are Square root transformed value of (X+0.5) was used for statistical analysis.

In maize during *Kharif* 2023, major weed flora observed in the experimental plots were *Cyperus rotundus, Digitaria marginata* and *Eleusine indica* (among grasses). Whereas, *Borreria hispida, Ageratum conyzoides, Commelina benghalensis*, *Acanthospermum hispidum, Oldenlandia corymbosa, Lonaidium sufruitcesum* and *Celosia argentea* were dominant BLWs. Among tillage practices, at 60 DAS, ZT plots recorded the lowest weed density (24.11 no./m²) and was on par with CT+R (24.89 no./m²). With respect to weed biomass, CT+R recorded the lowest weed biomass (10.22 g/m²). The plots imposed with CT numerically recorded the highest grain yield (2.80 t/ha) followed by ZT+R (2.79 t/ha). CT plots recorded the highest gross returns, net returns and B: C (Rs. 72250/ha, Rs. 31800 /ha and 1.79, respectively) while ZT+R recorded the comparable B: C (1.79).

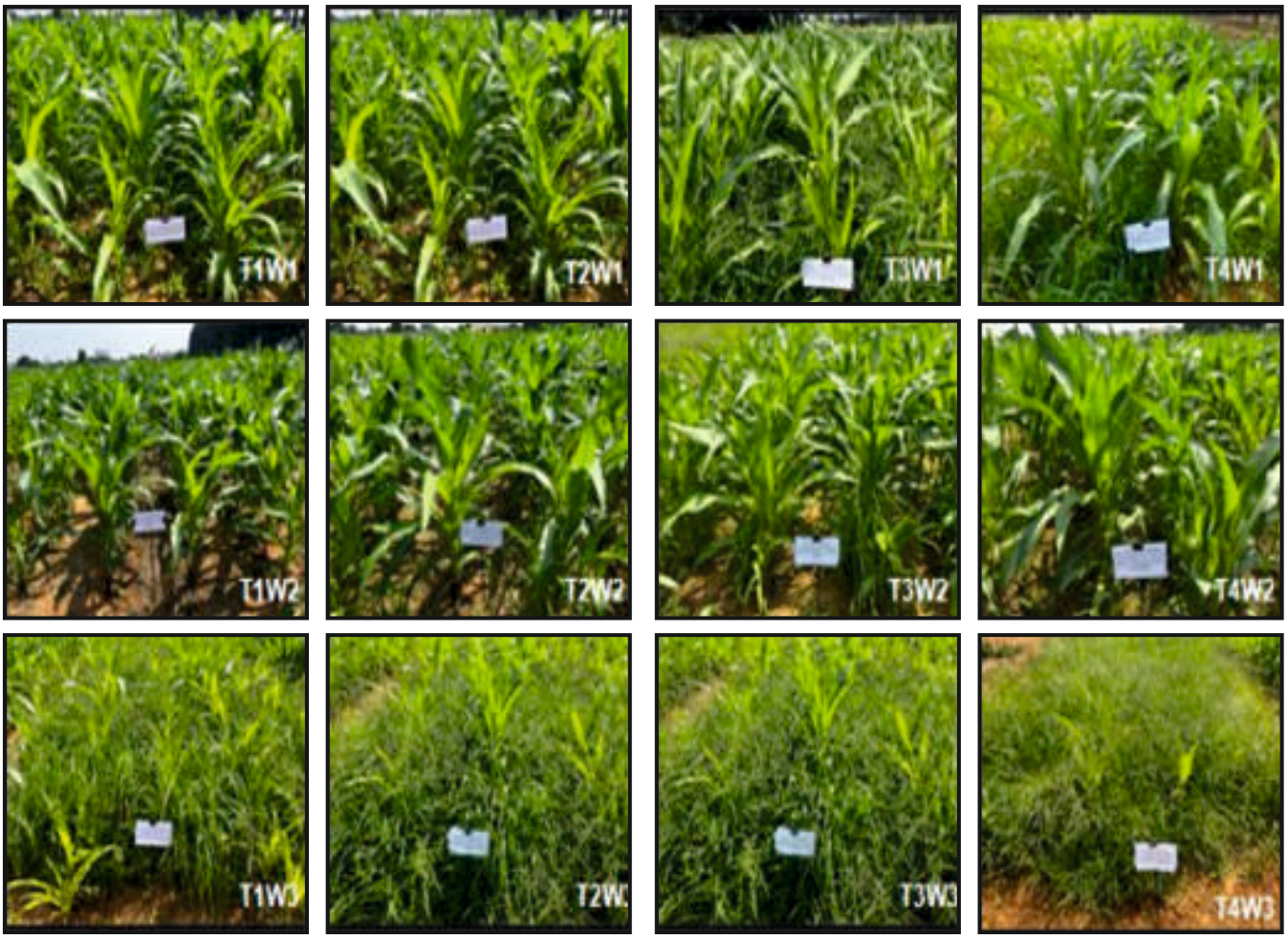
At 30 DAS and 60 DAS, pyroxasulfone 127.5 g/ha (2 DAS) *fb* tembotrione 120 g/ha (20 DAS) recorded the lowest weed density and biomass (13.50 no./m² and 7.00 g/m², respectively) followed by atrazine 1.0 kg/ha (2 DAS) *fb* topramezone 25.2 g/ha (20 DAS) *fb* HW (40 DAS) *fb* weed seed harvest (22.57 no./m² and 8.50 g/m², respectively) **(Table 1.2.12)**. In partially weedy check treatment, the highest weed density (29.25 no./m²) was recorded at 30 DAS. The same trend was observed for weed biomass. The plots received atrazine 1.0 kg/ha (2 DAS) *fb* topramezone 25.2 g/ha (20 DAS) *fb* HW (40 DAS) *fb* weed seed harvest recorded the highest grain yield (2.89 t/ha) compared to the recommended herbicide (2.61 t/ha). The lowest yield was obtained in partially weedy check (1.64 t/ha). IWM recorded the highest gross returns (Rs. 68250/ha) but the lowest net returns (Rs. 32560/ha) and B:C (1.91), while pyroxasulfone 127.5 g/ha (2 DAS) *fb* tembotrione 120 g/ha (20 DAS) recorded the highest net returns and B:C (Rs. 33,130/ha and 2.03, respectively).

Table 1.2.12. Effect of Crop establishment methods and weed management practices on weed parameters, yield, and economics in maize during *Kharif*, 2022

Treatments	Total weed density (no./m²)	Total weed biomass (g/m²)	Maize yield and economics (Rs./ha)					
			Grain yield (t/ha)	Weed index (%)	CoC (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs/ha)	B: C
Crop establishment								
CT	5.06(25.67)	3.67(13.00)	2.80	--	40,450	72,250	31,800	1.79
CT + R	5.00(24.89)	3.27(10.22)	2.15	--	40,450	53,750	13,300	1.33
ZT	4.92(24.11)	3.57(12.22)	2.09	--	38,980	52,250	13,270	1.34

Table contd...

ZT+ R	5.63(31.33)	4.28(17.78)	2.79	--	38,980	69,750	30,770	1.79
SEm±	0.30	0.47	0.54	NA	NA	NA	NA	NA
LSD (P=0.05)	0.90	1.41	1.62					
Weed management								
W_1	5.12(25.08)	3.57(11.83)	2.61	9.69	32,120	65,250	33,130	2.03
W_2	5.17(24.25)	3.43(11.33)	2.89	0.00	35,690	68,250	32560	1.91
W_3	5.16(30.17)	3.94(15.00)	1.64	43.25	29,650	41,000	11,350	1.38
SEm±	0.15	0.18	0.21	NA	NA	NA	NA	NA
LSD (P=0.05)	0.45	0.54	0.63					



PAU, Ludhiana

In mustard during *Rabi* 2022-23, among tillage and residue management, ZT+R had the lowest density of *Phalaris minor, Medicago denticulata, Rumex dentatus, Choronous didymus* and *Cyperus rotundus* while CT had the lowest density of *Avena ludoviciana.* ZT+R had the lowest biomass of all weed species while CT +R had the highest weed biomass of different weed species. ZT+R recorded the highest seed yield (1.56 t/ha) which was significant than all other tillage and residue management treatments.

Among weed management, IWM had the lowest density and biomass of all weeds than recommended herbicide and unsprayed control. In case of the recommended herbicide, *M. denticulata* and *C. didymus* had a similar density and biomass to unsprayed control. IWM recorded the highest seed yield while recommended herbicide recorded a seed yield similar to unsprayed (partial) control. Pinoxaden had a phytotoxic effect on mustard due to which the seed yield between recommended herbicide and control was at par **(Table 1.2.13)**.

Table 1.2.13. Growth, yield and yield attributes of mustard influenced by crop establishment methods and weed management practices during *Rabi* 2022-23

Treatments	Primary branches /plant	Secondary branches/plant	Plant height (cm)	No. of pods/plant	Pods length (cm)	Grain yield (t/ha)
Tillage and residue management						
CT+R	10.25	5.92	202.15	486.52	5.80	1.3
ZT+R	9.61	5.35	198.95	536.48	5.96	1.5
CT	10.05	5.39	197.25	501.52	5.86	1.1
ZT	10.60	5.28	193.43	466.40	5.63	1.3
LSD (p=0.05)	NS	NS	4.52	6.53	NS	.14
Weed management						
IWM	10.82	6.01	198.9	524.67	5.71	1.4
Herbicide	9.32	5.23	198.5	503.42	5.90	1.3
Control	10.23	5.21	196.3	465.10	5.83	1.2
LSD (p=0.05)	NS	NS	NS	7.56	NS	0.09

In greengram, during summer 2023, among tillage and residue management, ZT+R had the lowest weed density while CT (+/-R) had the lowest weed biomass; ZT had the highest weed biomass. ZT+R recorded the highest seed yield (1.19 t/ha) which was significantly higher than CT. Among weed management practices, recommended herbicide treatment had the lowest weed density and biomass **(Table 1.2.14)**. IWM had the highest seed yield (1.23 t/ha) which was at par to recommended herbicide.

Table 1.2.14. Weed parameters, growth, yield attributes and yield of greengram during summer 2023

Treatments	Weed density (no./m²)	Weed biomass (g/m²)	Branches (no./plant)	Pods (no./plant)	Seeds no./plant)	Seed yield (t/ha)
Main plot						
CT+R	2.84(7)	2.46(5)	8.27	21.96	98.67	1.16
ZT+R	1.50(2)	1.99(5)	9.57	21.33	95.44	1.19
CT	1.77(3)	1.69(2)	9.42	20.60	104.55	1.04
ZT	2.79(7)	3.19(11)	10.24	22.53	98.44	1.17
LSD (p=0.05)	0.19	0.30	1.18	0.24	5.98	0.12
Sub plot						
IWM	2.44(6)	2.33(5)	9.50	21.68	97.33	1.23
Herbicide	1.65(2)	1.45(1)	9.38	21.05	102.50	1.14
Control	2.58(6)	3.22(11)	9.25	22.08	98.00	1.06
LSD (p=0.05)	0.13	0.29	NS	0.32	3.21	0.13

*Original values are given in parenthesis, which were transformed to $\sqrt{x+1}$

In maize during 2023, *Cyperus compressus, C. rotundus, Digitaria snaguinalis, Echinochloa colona* and *Commelina benghalensis* were the major weeds. Among tillage and residue management, ZT+R had the lowest weed density while CT+R had the lowest weed biomass. (ZT+R) recorded the highest grain yield which was significantly higher than all other tillage and residue management treatments; CT recorded the lowest grain yield. The weed seed bank of *P. minor* did not influence by tillage and residue management, while *R. dentatus* and *A. arvensis* were highest with CT.

Among weed management practices, recommended herbicide provided complete control of all weed species. IWM had similar weed density but lower weed biomass to unsprayed control at an early stage. Recommended herbicide recorded the highest grain yield which significantly higher than IWM and unsprayed control **(Table 1.2.15)**.

Table 1.2.15. Effect of crop establishment methods and weed management on weed parameters and yield attributes of maize in 2023

Treatments	Weed density (no./m²)	Weed biomass (g/m²)	Cob length (cm)	Cob diameter (cm)	Grain yield (t/ha)
Tillage and residue management					
CT+R	3.53(24)	6.51(102)	23.0	11.6	5.36
ZT+R	3.61(25)	7.31(135)	24.6	12.8	6.27
CT	3.57(25)	6.32(96)	21.2	10.6	4.35
ZT	3.60(25)	6.95(119)	23.7	12.9	5.56
LSD (p=0.05)	NS	NS	1.96	NS	.51
Weed management					
IWM	1.00(0)	1.00(0)	23.3	12.3	5.67
Herbicide	1.00(0)	1.00(0)	25.7	13.5	6.36
Control	8.74(75)	18.33(340)	20.5	10.3	4.13
LSD (p=0.05)	0.22	1.15	1.15	0.73	.33

*Original values are given in parenthesis, which were transformed to $\sqrt{x+1}$

Weed seed bank study revealed that ZT+R had the lowest seed bank of *Dactyloctenum aegyptium* and *Echinochloa colona* after greengram harvest and maize harvest while the highest density was observed with CT. Among weed management, IWM had the lowest weed seed bank after both crop harvests **(Table 1.2.16)**. ZT+R recorded the highest dehydrogenase activity which was significantly higher than all other tillage and residue management treatments, and among weed management, IWM had the highest activity of dehydrogenase which was significantly higher than recommended herbicide treatment.

Table 1.2.16. Effect of crop establishment methods and weed management on viable weed seedbank at greengram and maize harvest

Treatment	At greengram harvest		At maize harvest		
	D. aegyptium	*E. colona*	*P. minor*	*Rumex*	*Anagallis*
Tillage and residue management					
CT+R	28.54 (841)	24.91 (645)	25.62 (693)	20.17 (458)	30.05 (924)
ZT+R	23.31 (577)	19.44 (411)	20.951(457)	17.00 (303)	20.96 (454)
CT	31.93 (1053)	28.48 (840)	22.34 (563)	24.24 (637)	29.34 (956)
ZT	26.02 (697)	22.73 (533)	21.14 (498)	23.02 (574)	27.32 (784)
LSD (p=0.05)	2.32	2.76	NS	4.69	4.56
Weed management					
IWM	21.65 (480)	18.47 (354)	16.59 (290)	15.89 (266)	20.06 (421)
Herbicide	26.63 (722)	23.08 (544)	20.59 (437)	20.66 (446)	27.44 (782)
Control	34.07 (1175)	30.12 (923)	30.36 (931)	26.78 (768)	33.25 (1136)
LSD (p=0.05)	1.50	1.55	2.80	4.79	2.49
Interaction LSD (p=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**

Data subjected to square root transformation. Figures in parentheses are means of original values.

CCSHAU, Hisar

In mustard during 2022-23, the density and biomass of weeds at 60 DAS were not influenced significantly by different tillage and residue management treatments, however, application of pendimethalin *fb* pinoxaden and pendimethalin *fb* hand weeding significantly reduced the density and biomass of weeds as compared to weedy check. Yield attributes and yield of mustard were also statistically at par among different tillage and residue management practices. Application of pendimethalin *fb* hand weeding resulted in higher primary branches per plant, number of siliquae per plant and seed yield which was at par with pendimethalin *fb* pinoxaden but significantly higher than weedy check **(Table 1.2.17)**. Microbial count was increased in the tillage system and maximum microbial count was observed in ZT+R results revealing non-significant effects on the microbial counts when weeds are chemically controlled.

Table 1.2.17. Effect of crop establishment methods and weed management on yield parameters and yield of mustard 2022-23

Treatments	Plant height at harvest (cm)	Primary branches/plant	No. of siliqua/ plant	Seed yield (t/ha)
Tillage and residue management				
CT	213.0	5.0	327.4	1·978
CT + R	217.0	4.9	309.4	1.947
ZT	213.0	4.9	309.3	1.897
ZT + R	211.0	4.8	310.0	1.992
SEm (±)	2.8	0.2	11.1	.53
LSD (p=0.05)	NS	NS	NS	NS
Weed management				
PMN *fb* PDN (339 *fb* 50 g/ha)	219.0	5.1	325.3	2.052
PMN *fb* HW (339 g/ha)	221.0	5.3	330.3	2.198
WC	200.0	4.3	286.0	1.609
SEm (±)	2.8	0.2	11.1	.45
LSD (p=0.05)	7.3	0.5	28.1	.135

PMN-Pendimethalin, PDN-Pinoxaden

Greengram during Summer 2023, *C. rotundus, E. colona* and *Euphorbia* sp. are the major weeds that infested the summer greengram in the maize-mustard-greengram cropping system at harvest. Tillage and residue management had no significant influence on density of different weeds at 60 DAS. However, application of pendimethalin 678 g/ha *fb* hand weeding resulted in significantly lower weed density of *C. rotundus* and *E. colona* followed by pendimethalin + imazethapyr 1000 g/ha (RM). The growth and yield attributes *i.e.* plant height, primary branches/plant and pod length were comparable among tillage and residue management. Application of pendimethalin *fb* hand weeding and pendimethalin + imazethapyr 1000 g/ha resulted in significantly taller plants, more primary branches and pod length with 59.5 and 49.4%, respectively higher seed yield as compared to weedy check **(Table 1.2.18)**.

Table 1.2.18. Effect of crop establishment methods and weed management on weed density at 60 DAS, yields attributes and yield of green gram

Treatments	*Cyperus rotundus* (no./m²)	*Echinochloa colona* (no./m²)	*Euphorbia sp.* (no./m²)	Plant height (cm)	Primary branches (no./plant)	Pod length (cm)	Seed yield (kg/ha)
Tillage and residue management							
CT	9.1 (84.0)	2.8 (8.9)	1.5 (1.5)	49.7	3.1	8.3	759.5
CT + R	9.0 (83.3)	3.0 (9.1)	1.3 (0.9)	49.1	3.3	8.2	775.7
ZT	9.2 (86.7)	3.3 (11.1)	1.2 (0.4)	50.4	3.1	8.2	790.0
ZT + R	9.8 (96.9)	3.1 (10.00	1.4 (1.1)	49.0	3.2	8.1	815.5
SEm (±)	0.2	0.1	0.1	1.5	0.3	0.1	34.2
LSD (p=0.05)	NS	NS	NS	NS	NS	NS	NS
Weed management							
Pendimethalin + imazethapyr 1000 g/ga	9.4 (88.0)	2.6 (6.0)	1.2 (0.7)	52.5	3.3	8.3	860.7
Pendimethalin 678 g/ha *fb* HW	7.6 (56.5)	2.0 (3.2)	1.4 (1.2)	51.3	3.5	8.4	919.2
Weedy check	10.9 (118.7)	4.6 (20.2)	1.4 (1.2)	44.8	2.7	7.8	576.0
SEm (±)	0.2	0.1	0.1	1.3	0.2	0.1	29.6
LSD (p=0.05)	0.5	0.3	NS	3.7	0.5	0.3	87.5

*Original values are given in parenthesis, which were transformed to $\sqrt{x+1}$

In maize during *Kharif* 2023, tillage and residue management treatments significantly influence the density of *C. rotundus* while the density of *E. colona* and *D. aegyptium* did not differ significantly at 40 DAS. While at 60 DAS, the lower density of weeds was obtained in CT over ZT. Weed biomass was significantly lower in CT

as compared to ZT at both stages resulting in higher weed control efficiency. Tillage and residue management had no significant influence on the yield attributes and yield.

Application of pyroxasulfone (127.5 g/ha) PE *fb* tembotrione (120 g/ha, PoE) resulted in significantly lower weed density and biomass, however, at 60 DAS atrazine (1000 g/ha, PE) *fb* topramezone (25.2 g/ha, PoE) *fb* hand weeding resulted in lower weed parameters. Weedy check resulted in significantly higher density of different weeds at both 40 and 60 DAS. Atrazine (1000 g/ha, PE) *fb* topramezone (25.2 g/ha, PoE) *fb* hand weeding resulted in 116.7% higher maize grain yield (4.3 t/ha) which was at par with pyroxasulfone (127.5 g/ha, PE) *fb* tembotrione (120 g/ha, PoE) with 109.6% more yield than weedy check **(Table 1.2. 19).**

Table 1.2.19. Effect of crop establishment methods and weed management on yield parameters and yield of maize

Treatments	*C. rotundus* (no./m²)	*E. colona* (no./m²)	*D. aegyptium* (no./m²)	Plant height at harvest (cm)	Dry weight/ plant (g)	Cob length (cm)	Yield (t/ha)
Main plots							
CT	7.0(50.2)	2.0 (4.9)	1.4 (1.1)	198.0	182.6	16.0	3.53
CT + R	7.1(52.8)	2.3 (5.5)	1.4 (1.1)	198.4	183.6	16.4	3.51
ZT	7.8(61.9)	2.6 (6.9)	1.9 (3.3)	195.7	177.8	16.4	3.35
ZT + R	7.6(60.3)	2.5 (6.7)	1.7 (2.2)	196.6	179.5	16.7	3.44
SEm (±)	0.18	0.1	0.1	3.0	3.3	0.4	.074
LSD (p=0.05)	0.5	0.3	0.3	NS	NS	NS	NS
Sub plots							
Pyroxasulfone 127.5 *fb* tembotrione 120 g/ha	6.8(45.5)	1.9 (3.3)	1.5 (1.5)	205.8	197.5	16.7	4.1
Atrazine 1.0 kg/ha *fb* topramezone 25.2 g/ha *fb* HW	5.7(32.0)	1.1 (0.3)	1.0 (0.0)	210.4	200.3	17.2	4.2
WC	9.6(91.5)	3.9(14.3)	2.3 (4.3)	175.4	144.8	15.2	1.9
SEm (±)	0.16	0.1	0.1	2.6	2.9	0.4	.06
LSD (p=0.05)	0.5	0.4	0.2	7.7	8.5	1.1	.19

RVSKVV, Gwalior

In mustard during *Rabi* 2022-23, the experimental field comprised *Phalaris minor, Spergula arvensis* and *Cynodon dactylon* as grasses and *Chenopodium album, Anagallis arvensis, Convolvulus arvensis, Rumex dentatus, Chichorium intibus* and *Medicago hispida* as major BLWs and *Cyperus rotundus* as sedges. *Cyperus rotundus* was the most dominating sedge among all the weeds. The lowest weed density and biomass at 30 and 60 DAS were observed with ZT+R. Lower weed parameters in ZT+R helped in synthesizing higher growth and yield attributes resulting in maximum mustard seed yield (1.76 t/ha). The same pattern was obtained for stover yield of mustard. Maximum net returns (Rs. 52730/ha) and B: C (3.64) were obtained in ZT+R followed by CT+R **(Table 1.2.20)**. The lowest B: C (2.17) was recorded in CT system.

All the weed management practices significantly influenced the density and biomass of weeds. The highest weed density and biomass were recorded in weedy check while the lowest was recorded where pendimethalin 339 g/ha at 2 DAS *fb* one hand weeding at 30 DAS *fb* WSH were applied. Lower weed parameters helped in obtaining maximum seed yield (1.87 t/ha), net returns (Rs. 56025/ha) and B: C (3.62) and it was *fb* pendimethalin 339 g/ha (2 DAS) *fb* pinoxaden 50 g/ha (after first irrigation).

Table 1.2.20. Crop establishment methods and weed management practices influence weeds, yield and economics in mustard under maize- based cropping system

Treatments	Weed density (no./m²)	Weed biomass (g/m²)	No. of branches/ plant	No. of siliqua/ plant	Grain yield (t/ha)	Net returns (Rs./ha)	B: C
Tillage and residue management							
CT-CT-CT	14.37 (235.22)	6.22	3.87	147.49	1.61	36059	2.17
CT+R-CT+R-CT+R	13.39 (214.00)	5.53	3.91	153.82	1.71	50908	3.57

Table contd...

ZT-ZT-ZT	15.90 (292.44)	6.82	3.78	144.87	1.56	44820	3.26
ZT+R-ZT+R-ZT+R	10.86 (146.33)	4.69	4.00	161.33	1.76	52730	3.64
SEm (±)	**0.80**	**0.58**	**0.11**	**6.12**	**0.07**		
LSD (p=0.05)	**2.76**	**2.02**	**0.39**	**21.19**	**0..36**		
Weed management							
Pendimethalin 339 g/ha (2 DAS) *fb* pinoxaden 50 g/ha (after first irrigation)	12.31 (157.08)	4.68	3.93	151.58	1.66	43054	2.68
Pendimethalin 339 g/ha (2 DAS) *fb* hand weeding (30 DAS) *fb* WSH	8.35 (79.75)	3.12	4.15	169.75	1.87	56025	3.62
Partially weedy (weeds removed after critical period)	20.23 (429.17)	9.65	3.58	134.30	1.45	41720	3.27
SEm (±)	**1.16**	**0.70**	**0.13**	**6.89**	**0.10**		
LSD (p=0.05)	**3.47**	**2.10**	**0.38**	**20.64**	**0.31**		

Pendimethalin 339 g/ha (2 DAS) *fb* hand weeding (30 DAS) *fb* WSH

Pendimethalin 339 g/ha (2 DAS) *fb* pinoxaden 50 g/ha (after first irrigation)

In maize during *Kharif* 2023, the ZT+R suppressed the narrow and BLWs up to 60 DAS whereas, no significant effect of any tillage treatment was seen on sedges. However, all the tillage and residue management treatments were comparable. ZT+R system recorded taller plants, more leaves/plant (8.71) and length of cob (16.19 cm) followed by CT+R system. These helped in obtaining maximum grain (2.87 t/ha) and stover (6.73 t/ha) yield, net returns (Rs.50765/ha) with B: C (2.73) followed by CT+R. The lowest grain and stover yield (1.81 and 5.94 t/ha, respectively) were recorded in ZT.

Similarly, the weed management practices significantly influenced the population of weeds at 30 and 60 DAS. The application of atrazine 1.0 kg/ha *fb* topramezone 25.2 g/ha with one hand weeding suppressed the weed density and biomass with the highest WCE 55.72% at 60 DAS. Lower weed parameters helped in obtaining taller plants (143.11 cm) and more leaves (8.6) with a higher grain (2.94 t/ha) and stover yield (6.91 t/ha) (Table 1.2.21).

Table 1.2.21. Effect of different tillage and weed management practices on weeds, yields and economics of maize crop at harvest stage

Treatment	Weed density (no./m²)	Weed biomass (g/m²)	Plant height (cm)	Grain yield (t/ha)	Stover yield (t/ha)	Net returns (Rs./ha)	B: C
Tillage and residue management							
CT-CT-CT	20.86(439.7)	8.13	143.32	2.50	6.10	39479	2.28
CT+R-CT+R-CT+R	20.16(412.2)	7.79	137.67	2.63	6.25	39341	2.14
ZT-ZT-ZT	20.42(421.8)	7.26	130.25	1.75	5.75	26461	1.98

Table contd...

ZT+R-ZT+R-ZT+R	20.59(429.4)	7.17	149.36	2.73	6.55	47253	2.62
SEm (±)	**0.67**	**0.36**	**5.86**	**0.21**	**0.33**	**5376**	**0.19**
LSD (p=0.05)	**2.31**	**1.26**	**20.29**	**0.73**	**1.14**	**18604**	**0.65**
Weed management							
Atrazine 1.0 kg/ha *fb* topramezone 25.2 g/ha	19.62(387.8)	6.05	150.81	2.23	6.03	34007	2.13
Atrazine 1.0 kg/ha *fb* topramezone 25.2 g/ha *fb* HW *fb* WSH	18.94(360.0)	5.68	136.28	2.86	6.91	47586	2.46
Partially weedy	22.96(529.5)	11.03	133.36	2.12	5.55	32807	2.17
SEm (±)	**0.51**	**0.58**	**3.89**	**0.20**	**0.31**	**5004**	**0.16**
LSD (p=0.05)	**1.53**	**1.73**	**11.65**	**0.59**	**0.93**	**15003**	**0.43**

WP 1.2.4. Weed management under conservation tillage system on soybean-based cropping system
Network Centres: CSKHPKV Palampur, MPUAT Udaipur

Treatment	Soybean	Wheat	Greengram/green manure
Main plot	**Tillageand residue management**		
	CT	CT	CT
	CT+R	CT+R	CT+R
	ZT	ZT	ZT
	ZT+R	ZT+R	ZT+R
Sub plot	**Weed management**		
Herbicide rotation	1st year: Diclosulam 28 g/ha (2 DAS) *fb* imazethapyr 100 g/ha (20 DAS) 2nd year: Sulfentrazone +clomazone 725 g/ha (2 DAS) *fb* propaquizafop + imazethapyr 125 g/ha (20 DAS) 3rd year Pendimethalin +imazethapyr 1.0 kg/ha (2 DAS) *fb* imazetapyr + imazamox 70 g/ha (20 DAS)	1st year: Clodinafop + metsulfuron 64 g/ha (20 DAS) 2nd year: Mesosulfuron + iodosulfuron 14.4 g/ha (20 DAS) 3rd year: Pinoxaden + carfentrazone 40 + 20 g/ha or Sulfosulfuron + metsulfuron 32 g/ha (20 DAS)	1st year: Pendimethalin + imazethapyr 1.0 kg/ha (2 DAS) 2nd year: Imazethapyr 100 g/ha (20 DAS) 3rd year: Pendimethalin 678 g/ha (2 DAS)
IWM	Pendimethalin+imazethapyr 1.0 kg/ha (2 DAS) *fb* hand weeding (30 DAS) *fb* weed seed harvest	Clodinafop+ metsulfuron 64 g/ha (30 DAS) *fb* HW (45 DAS)	Pendimethalin 678 g/ha (2 DAS) *fb* hand weeding (30 DAS)
Unweeded check	Partially weedy (weeds removed after critical period)	Partially weedy (weeds removed after critical period)	Partially weedy (weeds removed after critical period)

CSKHPKV, Palampur

In wheat during 2022-23, weed control treatments brought about significant variation in the count of *Avena ludoviciana*, *Phalaris minor* and *Tulipa asiatica*. Herbicide rotation treatment and INM treatment being at par gave significantly lower count of these weeds than the unweeded check treatment. Main effects of tillage and weed control treatments on the count of *Spergula arvensis* were not significant but their interaction was significant. However, trends in its count were not very conspicuous **(Table 1.2.22)**. Tillage treatments could not influence wheat grain yield. Under weed management treatments, HR-HR and IWM-IWM resulted in higher yield, net returns and B: C over the partially weedy check.

Table 1.2.22. Effect of crop establishment methods and weed management on yield and economics in wheat during 2022-23

Wheat grain yield (t/ha)	**M1**	**M2**	**M3**	**M4**	**Mean**
S1	3.5	3.3	2.8	2.9	3.1
S2	3.6	3.0	3.0	2.9	3.1
S3	2.3	1.9	2.2	2.2	2.2
Mean	3.1	2.7	2.7	2.7	
LSD (P=0.05)		M	S	M*S (1)	M*S (2)
		NS	.21	NS	NS
Net return (Rs./ha)					
S1	80144	69692	69918	70291	72511
S2	72314	43851	56903	59524	58148
S3	29013	10631	28579	24939	23291
Mean	60490	41391	51800	51585	
LSD (P=0.05)		M	S	M*S (1)	M*S (2)
B:C		NS	8062	NS	NS
S1	1.39	1.11	1.46	1.37	1.33
S2	0.99	0.57	0.90	0.90	0.84
S3	0.44	0.15	0.49	0.40	0.37
Mean	0.94	0.61	0.95	0.89	
LSD (P=0.05)		M	S	M*S (1)	M*S (2)
		0.22	0.12	NS	NS

In soybean during *Kharif* 2023, in the experimental field diverse weed flora comprised of *Ageratum conyzoides*, *Aeschynomene indica*, *Panicum dichotomiflorum*, *Sigesbeckia orientalis*, *Bidens pilosa*, *Cyperus spp.*, *Digitaria sanguinalis*, *Erigeron canadensis*, *Polygonum alatum* and *Ipomoea purpurea* were the major weeds. CTR-CTR recorded a significantly lower count of *Digitaria, Cyperus* spp., *Bidens pilosa*, *Ageratum conyzoides*, *Aeschynomene indica* than other tillage treatments. Tillage treatments could not influence soybean seed yield. Whereas CT and CTR with HR (sulfentrazone+ clomazone fb proquizafop + imazethapyr) gave the lowest weed count which is

followed by CT and CTR-IWM (pendimethalin +imazethapyr *fb* hand weeding *fb* weed seed harvest). The highest weed count was recorded in ZT than other tillage practices. In the case of ZT with weed management practice, unweeded check (weeds removed after critical period) gave the highest weed count. Under weed management treatments, HR-HR and IWM-IWM resulted in higher yield, net returns and B: C of soybean over the partially weedy check. The interaction between tillage and weed management treatments was significant for the seed yield of soybean **(Table 1.2.23)**.

Table 1.2.23. Effect of crop establishment methods and weed management on yield and economics in wheat during 2022-23

Soybean seed yield (t/ha)	M1	M2	M3	M4	Mean
S1	1.18	.92	.89	1.54	1.13
S2	1.07	1.11	.74	1.49	1.09
S3	.76	.82	.59	.75	.73
mean	1.01	.94	.74	1.26	
	LSD (P=0.05)	M	S	M*S (1)	M*S (2)
		NS	NS	NS	NS
Net returns (Rs./ha)					
S1	188776	187300	170063	183251	182347
S2	188630	168125	153088	178883	172181
S3	145855	130226	112571	200689	147335
Mean	174420	161884	145241	187607	
	LSD (P=0.05)	M	S	M*S (1)	M*S (2)
		NS	12055	24109	37620
B: C					
S1	3.08	2.80	3.19	3.17	3.06
S2	2.67	2.23	2.47	2.66	2.51
S3	2.12	1.78	1.89	2.93	2.18
Mean	2.62	2.27	2.52	2.92	
	LSD (P=0.05)	M	S	M*S (1)	M*S (2)
		0.41	0.15	0.30	0.48

MPUAT, Udaipur

In wheat during *Rabi* 2022-23, The major weed flora observed in the experimental field were grassy and broadleaf weeds including *Chenopodium album (2.06%), Chenopodium murale (2.11%), Fumaria parviflora (6.55%), Melilotus indica (2.21%), Convolvulus arvensis (1.65%), Avena fatua (3.15%), Phalaris minor (2.40%)* and *Malva parviflora (79.86%).*

Among tillage and residue management, CT-CT-CT system resulted in the lowest weed density and biomass. Lower weed parameters in the CT system led to taller plants, grain/ear, test weight and grain yield, while CT+R system recorded higher straw yield. Maximum net returns and B: C were recorded with CT+R system **(Table 1.2.24)**.

Among weed management practices, IWM (clodinafop+ metsulfuron 64 g/ha (30 DAS) *fb* HW (45 DAS) recorded the lowest weed density and biomass at 60 DAS. Lower weed parameters in IWM obtained maximum grain/ear, test weight, grain yield and straw yield. The maximum net returns were recorded in IWM.

Table 1.2.24. Effect of crop establishment methods and weed management on growth, yield and economics of wheat in soybean-wheat cropping system

Treatment	Plant height (cm)	Grains/ear	Test weight (g)	Grain Yield (t/ha)	Straw yield (t/ha)	Net returns (Rs./ha)	B:C
Tillage and residue management							
TRM1	72.91	**42.03**	41.63	3.59	3.84	69553	2.53
TRM2	70.44	**40.64**	41.89	3.68	3.78	72707	2.79

TRM3	73.15	**41.34**	42.96	3.49	3.69	68121	2.61
TRM4	71.77	**39.38**	39.68	3.35	3.64	59880	1.93
SEm±	2.12	**0.51**	0.52	0.06	0.07	1328	0.05
LSD (P=0.05)	NS	**1.76**	1.78	0.21	NS	4596	0.18
Weed management							
W1	76.12	**43.15**	42.62	3.78	3.97	75519	2.89
W2	72.80	**43.40**	43.19	4.00	4.07	75775	2.44
W3	67.28	**35.98**	38.80	2.80	3.18	51402	2.07
SEm±	1.34	**0.38**	0.35	0.05	0.06	1204	0.05
LSD(P=0.05)	4.01	**1.14**	1.04	1.50	1.68	3608	0.14
Interaction LSD	NS	**NS**	Sig	NS	NS	NS	NS

In soybean during *Kharif* 2023, the experimental plot was infested with *Echinochloa colona (24.58%), Eleusine indica (7.90%), Dinebra retroflexa (38.24%), Digera arvensis (13.05%), Commelina benghalensis (3.54%), Physalis minima (2.77%), Trianthema portulacastrum (2.89%), Cynodon dactylon (5.28%) and Amaranthus viridis (1.73%)*. At 60 DAS, CT-CT-CT resulted in lowest weed density and biomass. However, CT-CT-CT resulted in the maximum no. of pods per plant, pod weight per plant, and seed yield. The highest net returns and B: C were realized with CT-CT-CT.

Among weed management, IWM (Piclosulam 28 g/ha (2 DAS) *fb* imazethapyr 100 g/ha (20 DAS)] resulted in the lowest weed density and biomass at 60 DAS and harvest. Diclosulam 28 g/ha (2 DAS) *fb* imazethapyr 100 g/ha (20 DAS) registered maximum seed index and no. of pods/plant while pendimethalin+imazethapyr 1.0 kg/ha (2 DAS) *fb* hand weeding (30 DAS) *fb* weed seed harvest resulted in highest seed and haulm yield. While diclosulam 28 g/ha (2 DAS) *fb* imazethapyr 100 g/ha (20 DAS) registered maximum net returns and B: C **(Table 1.2.25)**.

Table 1.2.25. Effect of crop establishment methods and weed management on yield and yield attributes of soybean 2023

Treatment	No. of pods per plant	Seed yield (t/ha)	Haulm yield (t/ha)	Net returns (Rs./ha)	B:C
Tillage and residue management					
TRM1	47.84	1.47	1.89	50281	1.82
TRM2	44.40	1.46	1.92	45101	1.37
TRM3	44.13	1.41	1.83	46775	1.64
TRM4	38.89	1.25	1.62	36366	1.17
S.Em.±	1.45	.04	.05	2071	0.07
LSD (P=0.05)	5.01	.14	.19	7166	0.24
Weed management					
W1	50.59	1.66	2.19	56267	1.86
W2	53.72	1.77	2.37	60135	1.85
W3	27.14	.76	.88	17490	0.80
S.Em.±	1.05	.03	.04	1689	0.06
LSD (P=0.05)	3.16	.10	.12	5064	0.18
Interaction LSD	Sig	NS	NS		

WP 1.2.4 Weed management under conservation tillage system on cotton-based cropping system
Network Centres: AAU Anand, PJTSAU Hyderabad, TNAU Coimbatore

Treatment	Cotton	Maize/baby corn	Greengram/green manure
Main plot	Tillage and residue management		
	CT	CT	CT
	CT+R	CT+R	CT+R
	ZT	ZT	ZT
	ZT+R	ZT+R	ZT+R

Table contd...

Sub plot	*Weed management*		
Herbicide rotation	1st year: Diuron 0.75 kg/ha PE *fb* pyrithiobac sodium 6% EC + quizalofop ethyl 4% EC w/w MEC 125 g/ha (2-3 weed leaf stage) *fb* directed spray (inter-row) of glufosinate ammonium 13.5% SL 500 g/ha (50-55 DAS) 2nd year: Pendimethalin 30% EC 1.0 kg/ha (2 DAS) *fb* pyrithiobac sodium 6% EC + quizalofop ethyl 4% EC w/w MEC 125 g/ha (2-3 weed leaf stage) *fb* directed spray (inter-row) of paraquat dichloride 24% SL 500 g/ha (50-55 DAS)	1st year: Atrazine 1.0 kg/ha (2 DAS) *fb* topramezone 25.2 g/ha (20 DAS) 2nd year: Atrazine 1.0 kg/ha (2 DAS) *fb* tembotrione 120 g/ha (20 DAS) 3rd year: Atrazine + mesotrione 875 g/ha (20 DAS)	1st year: Pendimethalin + imazethapyr 1.0 kg/ha (2 DAS) 2nd year: Imazethapyr 100 g/ha (20 DAS) 3rd year: Pendimethalin 678 g/ha (2 DAS)
IWM	Diuron PE 0.75 kg/ha *fb* pyrithiobac sodium 6% EC + quizalofop ethyl 4% EC w/w MEC 125 g/ha (2-3 weed leaf stage) *fb* directed spray (inter-row) of glufosinate ammonium 13.5% SL 500 *fb* hand weeding (50-55 DAS) *fb* weed seed harvest	Atrazine 1.0 kg/ha (2 DAS) *fb* topramezone 25.2 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest	Pendimethalin 678 g/ha (2 DAS) *fb* hand weeding (30 DAS)
Unweeded check	Partially weedy (weeds removed after critical period)	Partially weedy (weeds removed after critical period)	Partially weedy (weeds removed after critical period)

AAU, Anand

Weed management in cotton-greengram cropping system under conservatio agriculture

In cotton, at 60 DAS, indicated that species wise density of monocot weed (*Eleusine indica, Dactyloctenium aegyptium, Digitaria sanguinalis, Commelina benghalensis* and *Chloris barbata*) was found to be non-significant but dicot weeds (*Digera arvensis, Phyllanthus niruri, Oldenlandia umbellata, Vernonia cinerea, Physalis minima, Amaranthus viridis, Mollugo nudicaulis*) and total weed. Significantly lower density of *Digera arvensis, Phyllanthus niruri, Vernonia cinerea, Physalis minima, Amaranthus viridis* due to tillage and crop residue management practices in cotton at 60 DAS were influenced by tillage and crop residue management and lower value obtained with ZT+R. Plant height and seed cotton yield was comparable with various tillage and residue management. ZT recorded the lowest weed density (118 no./m^2) and highest with CT (195 no./m^2) while CT+R had lowest weed biomass (124 g/m^2) and highest with CT (140 g/m^2). Seed cotton yield was comparable among tillage and residue management, numerically higher seed cotton and stalk yield recorded with CT **(Table 1.2.26)**.

Among weed management practice, application of pyrithiobac sodium 3.1% w/w + pendimethalin 34% w/w ZC 742 g/ha (2 DAS) *fb* pyrithiobac sodium 6% EC + quizalofop ethyl 4% EC w/w MEC 125 g/ha (4-6 weed leaf stage) *fb* directed spray (inter-row) of glufosinate ammonium 13.5% SL 450 g/ha at 50-55 DAS recorded with lower weed density (59.1 no./m^2) and biomass (26.8 g/m^2) with highest stalk yield. Seed cotton yield was comparable but pyrithiobac sodium 3.1% w/w + pendimethalin 34% w/w ZC 742 g/ha (2 DAS) *fb* pyrithiobac sodium 6% EC + quizalofop ethyl 4% EC w/w MEC 125 g/ha (4-6 weed leaf stage) *fb* directed spray (inter-row) of glufosinate ammonium 13.5% SL 450 g/ha at 50-55 DAS and pyrithiobac sodium 3.1% w/w + pendimethalin 34% w/w ZC 742 g/ha (2 DAS) *fb* HW at 30 and 60 DAS *fb* weed seed harvest were comparable.

Table 1.2.26. Weed parameters and yield of cotton influenced by crop establishment methods and weed management practices in cotton–greengram cropping system

Treatment	Weed density (no./m²)	Weed biomass (g/m²)	Seed cotton yield (t/ha)	Stalk yield (t/ha)
Tillage and residue management				
CT	13.5(195)	10.32(140)	2.72	5.29
CT+R	11.5(158)	9.53(124)	2.58	5.22
ZT	10.1(118)	9.73(146)	2.71	5.26
ZT+R	13.1(194)	9.60(139)	2.55	5.25
SEm±	0.6	0.56	0.10	0.17
LSD (p=0.05)	1.95	NS	NS	NS
CV %	15.2	17.0	10.96	9.74
Weed management				
Pyrithiobac sodium 3.1% w/w + pendimethalin 34% w/w ZC 742 g/ha (2 DAS) *fb* pyrithiobac sodium 6% EC + quizalofop ethyl 4% EC w/w MEC 125 g/ha (4-6 weed leaf stage) *fb* directed spray (inter-row) of glufosinate ammonium 13.5% SL 450 g/ha at 50-55 DAS	7.29(59.1)	4.92(26.8)	3.24	6.10
Pyrithiobac sodium 3.1% w/w + pendimethalin 34% w/w ZC 742 g/ha (2 DAS) *fb* HW at 30 and 60 DAS *fb* weed seed harvest	12.2(158)	6.13(39.2)	3.25	5.94
Partially weedy (weeds removed after critical period)	16.6(282)	18.3(346)	1.44	3.71
S. Em. ±	0.73	0.77	0.0796	0.14
LSD (p=0.05)	**2.20**	**2.30**	**0.24**	**0.43**
CV %	21.1	27.2	10.4	9.4
Interaction TxW	**NS**	**NS**	**NS**	**NS**

PJTSAU, Hyderabad

In maize during *Rabi* 2022-23, the total weed density data recorded at 30 and 60 DAS reveals that weed density and biomass was significantly lower in CT compared to ZT and ZT+R at 30 DAS but comparable at 60 DAS. The kernel yield of maize was also comparable in CT, ZT and ZT+R. The stover yield and harvest index were also not influenced by the tillage practices. The cost of cultivation was higher with CT compared to ZT and ZT+R plots. But, the gross returns, net returns and B: C was superior in ZT and ZT+R plots compared to CT. The highest cotton equivalent yield (CEY) was recorded in CT-CT but was at par with both CT-ZT-ZT and ZT+R-ZT+R- ZT+R **(Table 1.2.27)**.

Among the weed management methods, at 30 DAS, weed density was lower in chemical treatments (W_1 and W_2) compared to IWM, while weed biomass was lower with IWM. Higher kernel and stover yield was obtained in chemical weed control (W_1 & W_2) over IWM (W_3) which were superior to HW at 50 DAS (W_4). The highest B: C was obtained in ZT+R with chemical weed control (2.75) followed by ZT and chemical weed control (2.66). The highest CEY was obtained in chemical weed control (W_1) and (W_2) which was superior to IWM (W_3). The highest gross returns, net returns and B: C were registered with T_3 (ZT+R- ZT+R- ZT+R) + W_1 (chemical weed control) (266561, 152615 and 2.34, respectively). It was followed by T_2 (CT-ZT-ZT) + W_1 (chemical weed control) with 263126, 149180 and 2.31 (GR, NR and B: C, respectively).

Table 1.2.27. Weed density, biomass, yield and cotton equivalent yield as influenced by tillage and weed management in maize under conservation agriculture (*Rabi*, 2022-23).

Treatment	Weed density at 30 DAS (no./m²)	Weed density at 60 DAS (no./m²)	Weed biomass at 30 DAS (g/m²)	Weed biomass at 60 DAS (g/m²)	Grain yield (t/ha)	Stover yield (t/ha)	HI (%)	Cotton equivalent yield (l/ha)
Tillage and residue management								
CT-CT	7.64	6.06	4.95	3.94	6.44	8.51	43.04	3.67
CT-ZT-ZT	9.00	6.21	6.32	5.45	5.82	7.75	42.44	3.40
ZT+R- ZT+R-ZT+R	9.89	6.49	6.69	5.33	6.30	7.96	43.88	3.61
LSD (p=0.05)	0.70	NS	0.48	0.32	NS	NS	NS	NS
Weed management								
Chemical Management	7.29	6.42	5.16	5.20	7.51	8.83	45.94	4.19
Herbicide rotation	7.37	6.68	5.16	5.17	7.22	9.13	44.21	4.05
IWM	9.16	9.28	5.38	6.25	5.75	8.25	41.13	3.18
HW at 50 DAS (control)	11.57	2.64	8.25	2.99	4.27	6.08	41.19	2.63
LSD (p=0.05)	0.57	0.78	0.29	0.34	.41	.59	2.49	.16

In cotton during Kharif 2023, loss of cotton germination was observed due to the application of diuron and pendimehtalin which was followed by heavy rain immediately after application. Light yellowing of margins of cotyledon leaves was observed due to diuron application, which later on disappeared. No phytotoxic symptoms were observed on true leaves. The weed density and biomass was significantly lower in CT plots compared to ZT plots at 30 DAS. Whereas at 60 DAS, the difference was not significant. The kapas yield was not influenced under tillage **(Table 1.2.28)**.

The IWM treatment was not effective as the weeds rejuvenated especially grassy weeds immediately after brush cutting. The weed count significantly higher in ZT+R with IWM plots compared to all the herbicide and tillage combinations. Due to hand weeding at 55 DAS, weed count was lower in control plots. Plot receiving herbicide rotation recorded lower weed count. Application of herbicides was found to be reducing the weed biomass significantly compared to IWM. Herbicide treatments was better than IWM. But in IWM, early boll bursting was noticed.

Table 1.2.28. Weed count, biomass and Kapas yield as influenced by tillage and weed management in cotton under conservation agriculture (*Kharif*, 2023)

Treatment		Weed count (no. /m²)		Weed biomass (g/ m²)		Kapas yield (t/ha)
Tillage		**30 DAS**	**60 DAS**	**30 DAS**	**60 DAS**	
T_1- CT(cotton)	W_1	6.95 (47.33)	5.62 (30.67)	3.82 (13.66)	10.06 (100.22)	1.69
- CT (maize)	W_2	7.74 (59.00)	6.05 (35.67)	3.98 (14.86)	8.63 (73.49)	1.89
	W_3	7.64 (57.33)	6.91 (47.00)	4.76 (21.74)	12.25 (149.20)	.99
	W_4	9.47 (88.67)	4.70 (21.33)	7.13 (49.88)	6.23 (38.22)	.24
T_2- CT(cotton)	W_1	7.70 (58.33)	6.23 (38.00)	4.99 (23.98)	11.58 (133.31)	1.95
- ZT (maize)	W_2	6.49 (41.33)	5.71 (31.67)	4.66 (20.80)	11.55 (133.03)	2.17
- ZT (GM)	W_3	6.78 (45.00)	7.46 (54.67)	4.70 (21.07)	12.28 (149.87)	.89
	W_4	10.34(106.00)	4.77 (22.00)	9.18 (83.23)	8.23 (66.78)	.22
T_3-	W_1	9.22 (84.33)	5.70 (31.67)	6.85 (45.90)	11.30 (126.91)	2.06
ZT+R(cotton)	W_2	9.16 (83.00)	6.09 (36.33)	6.51 (41.40)	12.77 (162.07)	1.79

Table contd...

-	W_3	8.10 (64.67)	6.99 (48.00)	5.14 (25.40)	15.34 (235.75)	1.12
ZT+R(maize) - ZT+R(GM)	W_4	12.48 (154.67)	6.24 (38.00)	12.85 (164.24)	6.22 (37.72)	.35
Mean						
Tillage (Main plots)						
T_1- CT(cotton) - CT (maize)		7.95	5.82	4.92	9.29	1.20
T_2- CT(cotton) - ZT (maize) - ZT (GM)		7.83	6.04	5.88	10.91	1.31
T_3- ZT+R(cotton) - ZT+R(maize)- ZT+R(GM)		9.74	6.26	7.83	11.40	1.32
Weed Management (Sub plots)						
W_1 – Chemical weed control		7.96	5.85	5.22	10.98	1.90
W_2 – Herbicide rotation		7.80	5.95	5.05	10.98	1.95
W_3 – IWM		7.51	7.12	4.87	13.29	1.01
W_4- Control		10.76	5.24	9.72	6.89	.27

	SE(m) ±	LSD (p=0.05)	SE(m) ±	LSD (p=0.05)	SE(m) ±	LSD (p=0.05)	SE (m) ±	LSD (p=0.05)	SE (m) ±	LSD (p=0.05)
Tillage	0.098	0.289	0.146	NS	0.069	0.279	0.120	0.484	.027	NS
Weed Management	0.113	0.333	0.152	0.456	0.092	0.276	0.226	0.677	.038	.114
SUB AT SAME	0.196	0.577	0.292	0.869	0.139	0.511	0.240	1.218	.053	.210
LEVEL OF MAIN MAIN AT SAME LEVEL OF SUB			0.271	0.893	0.155	0.495	0.360	1.119	.062	.202

*Figures in parentheses are original values and data is subjected √x+1 transformation
CT – conventional tillage; ZT – zero tillage; R – residue cover; GM – green manure (*Sesbania*)

The highest weed density and biomass were recorded in ZT+R compared to CT plots. The seed cotton yield was highest in ZT+R-ZT+R-ZT+R which was 5.3% superior to CT-ZT-ZT and 11.9% more than CT-CT. The CEY in CT-ZT-ZT was also superior by 6.2% over CT-CT.

Among the weed management methods, the lowest weed density and biomass were observed in IWM. The IWM treatment was ineffective as the weeds rejuvenated, especially grassy, immediately after brush cutting. However, in IWM, early boll bursting was noticed. Chemical weed control (diuron *fb* pyrthiobac+quizalofop ethyl *fb* paraquat) recorded the highest seed cotton yield which was at par with herbicide rotation (pendimethalin *fb* pyrthiobac+quizalofop ethyl *fb* paraquat) and superior to IWM (Table 1.2.29). The highest CEY was obtained in chemical weed control which was superior to the other methods. IWM was the next best method. Similarly, the highest gross returns, net returns, and B: C were registered with ZT+R-ZT+R-ZT+R coupled with chemical weed control (264725, 150779 Rs/ha, and 2.32, respectively). It was followed by CT-ZT-ZT coupled with chemical weed control (236347, 122401 Rs/ha, and 2.07, respectively).

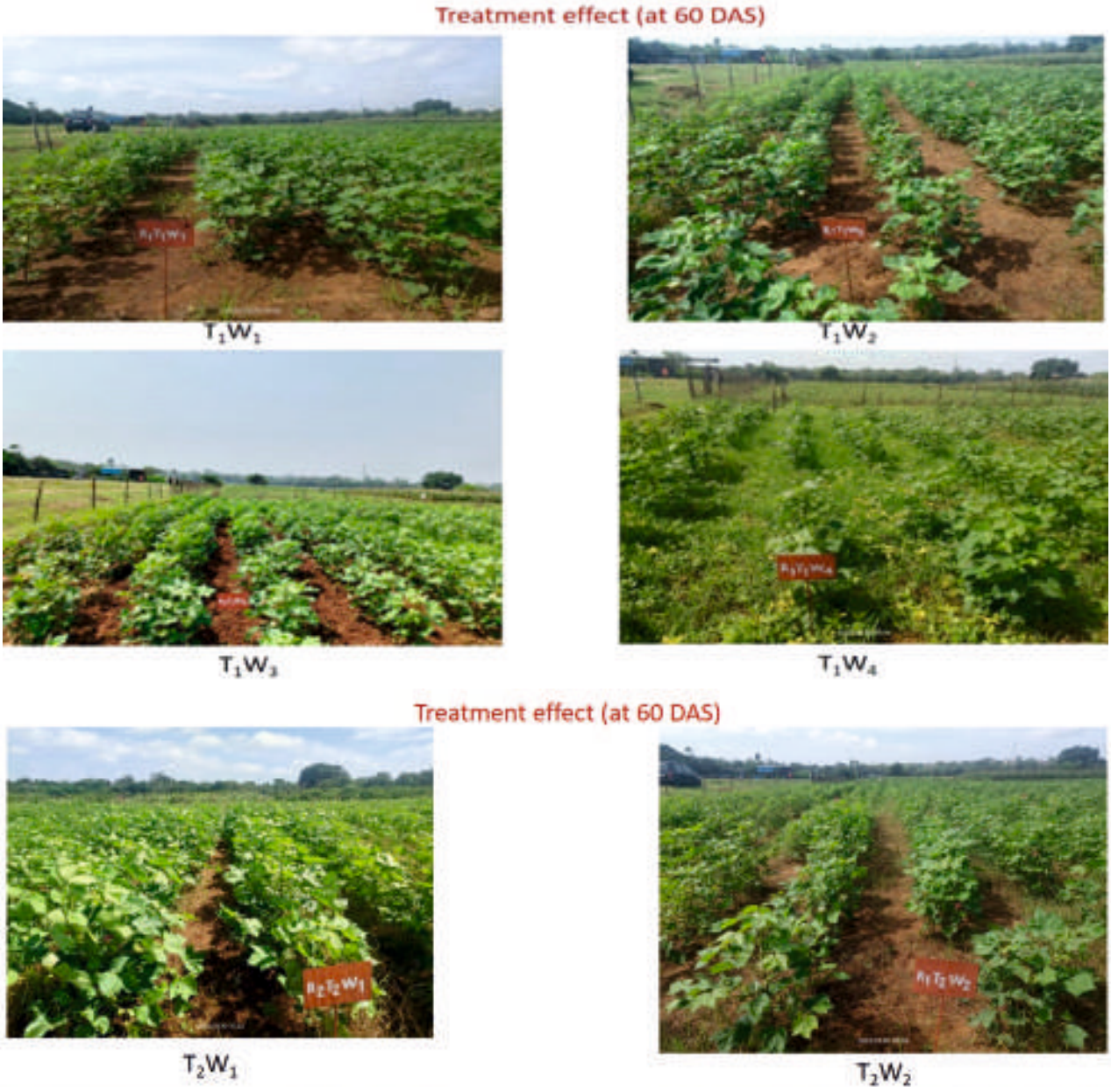
Table 1.2.29. Weed density, biomass and yield as influenced by crop establishment methods and weed management in cotton (*Kharif* 2023).

Treatment	Weed density at 30 DAS (no./m²)	Weed density at 60 DAS (no./m²)	Weed biomass at 30 DAS (g/m²)	Weed biomass at 60 DAS (g/m²)	Kapas yield (t/ha)
Tillage and residue management					
T_1- CT(cotton) - CT (maize)	6.92 (49.51)	5.76 (34.58)	5.92 (36.58)	6.80 (45.41)	1.49
T_2- CT(cotton) - ZT (maize) - ZT (GM)	7.36 (55.56)	5.87 (31.83)	5.68 (33.08)	6.83 (45.84)	1.54

Table contd...

T_3- ZT+R(cotton) - ZT+R(maize) - ZT+R(GM)	8.02 (67.05)	6.25 (38.08)	7.24 (55.57)	9.23 (87.05)	1.53
LSD (p=0.05)	0.69	0.17	0.51	0.33	.01
Weed management					
W_1 – Chemical weed control	6.72 (44.59)	6.81 (44.44)	5.10 (25.67)	7.66 (60.54)	1.77
W_2 – Herbicide rotation	5.79 (33.07)	5.97 (34.89)	4.46 (19.01)	7.72 (59.72)	1.72
W_3 – IWM	7.27 (52.77)	7.17 (46.22)	7.14 (51.58)	8.57 (75.70)	1.32
W_4- Control	9.96 (99.08)	3.90 (13.78)	8.42 (70.71)	6.53 (41.76)	1.25
LSD (p=0.05)	0.46	0.27	0.44	0.31	.04

Effect of tillage treatments and weed management options on cotton growth



T_2W_3

T_2W_4

Treatment effect (at 60 DAS)

T_3W_1

T_3W_2

T_3W_3

T_3W_4

TNAU, Coimbatore

Weed management in cotton-baby corn-based cropping system under conservation agriculture

In baby corn during *Rabi* 2022-23, the predominant weed flora of the experimental field consisted of eight species of BLWs, seven species of grasses and a sedge weed. The predominant among BLWs were *Amaranthus viridis, Cleome viscosa*, *Trianthema Portulacastrum* and *Parthenium hysterophorus*. Among the grasses, *Cynodon dactylon, Setaria verticiliata, Dactyloctenium aegyptium, Rottboellia cochinchinensis* were the dominant weeds. *Cyperus rotundus* was the only sedge present. Among tillage methods, significantly lower total weed density and biomass (4.16/m^2 and 2.54 g/m^2, respectively) with higher WCE (69.6%) were recorded in the CT-ZT-ZT system at 30 DAS with taller plants and more dry matter production at 45 DAS. A significantly higher cob yield of 4.41 t/ha was recorded with CT-ZT-ZT system (**Table 1.2.30**).

Among weed management practices, atrazine 1.0 kg/ha (PE) *fb* brush cutter on 45 DAS recorded lower weed density and biomass (2.95 /m^2 and 1.60 g/m^2, respectively), higher weed control efficiency (85.6%), taller plants and higher yield (171.5 cm and 5.34 t/ha, respectively) and it was followed by topramezone 12.5 g/ha + 2, 4 D 500 g/ha at 20-25 DAS (EPoE). Atrazine 1.0 kg/ha *fb* brush cutter on 45 DAS for weed management

treatments recorded. The lowest cob yield was recorded with control.

In summer 2023, tillage and weed management treatments did not significantly influence the green biomass yield of Dhaincha. The highest green biomass was recorded with zero tillage along with herbicide applied plot of the previous crop.

In cotton during *Kharif* 2023, among tillage methods, at 60 DAS significantly lower total weed density and biomass (22.3/m^2 and 7.69 g/m^2, respectively) were recorded in ZT+R system with the highest WCE (55.4%).

Among weed management practices, application of pyrithiobac sodium 3.1 w/w +pendimethalin 34 w/w ZC 742 g/ha (2 DAS) *fb* pyrithiobac sodium 6 EC + quizalofop ethyl 4 EC w/w MEC 125 g/ha (4-6 weed leaf stage) *fb* directed spray (inter-row) of glufosinate ammonium 13.5 SL 450 g/ha at 50-55 DAS recorded significantly lower weed density and biomass (10.10 /m^2 and 3.79 g/m^2, respectively) with higher WCE (79.8%).

Table 1.2.30. Effect of crop establishment methods and weed management practices on yield of baby corn, green manure biomass and weeds in cotton under cotton-based cropping system

Treatment	Babycorn			Green manure biomass yield (t/ha)	Cotton			
	Plant height (cm)	DMP (t/ha)	Cob Yield (t/ha)		Treatment	Total Weed density (no./m^2)	Total Weed biomass (g/m^2)	WCE (%)
Tillage and residue management								
T1(CT-CT-ZT)	144.5	4.72	3.70	14.3	CT-CT-CT	5.04 (26.88)	3.06 (9.50)	46.2
T_2(CT-ZT-ZT)	154.3	5.43	4.41	15.4	CT+R-CT+R-CT+R	4.94 (26.24)	2.99 (9.16)	47.5
T_3(ZT+(R)-ZT+(R)-ZT+(R))	147.6	4.80	3.78	14.7	ZT-ZT-ZT	4.72 (24.27)	2.84 (8.73)	51.4
	2.6	.12	.179	0.9	ZT+R-ZT+R-ZT+R	4.34 (22.30)	2.63 (7.69)	55.4
SEm±	7.4	.35	.49	NS		0.02	0.01	-
LSD (P=0.05)	144.5	4.72	3.70	14.3		0.07	0.03	-
Weed management								
W_1 - Recommended herbicides (Pendimethalin 1.0 kg/ha)	151.2	4.68	3.66	14.7	W1- Herbicide rotation	3.21 (10.10)	2.04 (3.78)	79.8
W_2 - PE Atrazine 1.0 kg/ha *fb* BC on 45 DAS	171.5	6.36	5.34	15.6	W2- IWM	3.97 (15.46)	2.40 (5.32)	69.1
W_3 - EPOE Topramezone 12.5 g/ha + 2,4 D 500 g/ha at 20-25 DAS	163.3	4.93	3.91	15.0	W3- Unweeded check	7.10 (49.96)	4.20 (17.22)	-
W_4 - Unweeded check	109.3	3.96	2.94	13.8				
SEm±	5.4	.20	.13	1.8		0.05	0.03	-
LSD (P=0.05)	11.5	.42	.27	NS		0.11	0.06	-

Baby corn: W1: Recommended herbicides (Pendimethalin 1.0 kg/ha); W2: PE Atrazine 1.0 kg/ha + BC on 45 DAS; W3: EPOE Topramezone 12.5 g/ha + 2,4 D 500 g/ha at 20-25 DAS; W4: Unweeded check

Green manuring: W1-W4: hand weeding at 20-25 DAS

Cotton W1: Herbicide rotation (pyrithiobac sodium 3.1% w/w +pendimethalin 34% w/w ZC 742 g/ha (2 DAS) *fb* pyrithiobac sodium 6% EC + quizalofop ethyl 4% EC w/w MEC 125 g/ha (4-6 weed leaf stage) *fb* directed spray (inter-row) of glufosinate ammonium 13.5% SL 450 g/ha at 50-55 DAS); W2: pyrithiobac sodium 3.1% w/w +pendimethalin 34% w/w ZC 742 g/ha (2 DAS) *fb* HW at 30 and 60 DAS *fb* weed seed harvest; W3: Unweeded check.

WP 1.3 Weed management strategies in organic agriculture/natural farming

WP-1.3.1 Weed management in organically grown direct-seeded finger millet–pulse cropping system

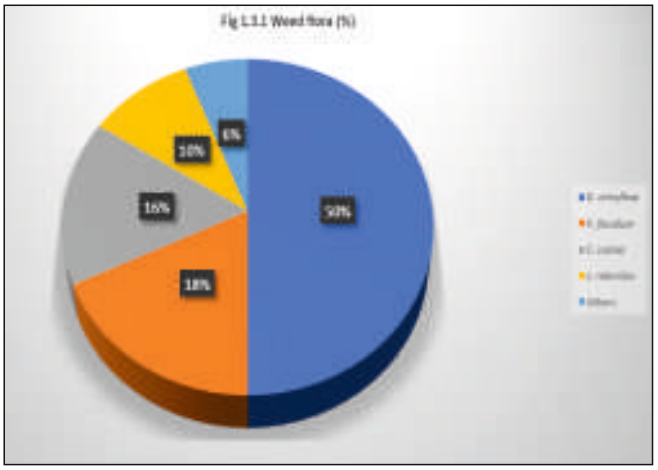
Network centres: ICAR-DWR, Jabalpur, UAS, Bengaluru

Treatments:

1. Reduced spacing (20 cm) *fb* 1 HW 20 DAS
2. Normal spacing (30 cm) *fb* 1 HW 20 DAS
3. Stale seedbed *fb* 1 HW 20 DAS
4. Mechanical weeding *fb* 1 HW 20 DAS
5. Sesbania *in situ* incorporation at 30 DAS
6. Crop residue mulch 6 t/ha *fb* 1 HW 20 DAS
7. Two HW (20 & 40 DAS)
8. Unweeded check

ICAR-DWR, Jabalpur

The field experiment on weed management in direct-sown organic finger millet crop (var. GPU 45) was conducted during *Kharif* 2023. Eight treatments were evaluated in RBD replicated thrice. The crop was applied vermicompost @ 5 t/ha. The weed flora composition is mentioned in **Fig 1.3.1**



The weed management treatments i.e., mechanical weeding 20 DAS *fb* 1 HW 40 DAS, two HW (20 & 40 DAS), mulch 6 t/ha *fb* 1HW 20 DAS, stale seedbed *fb* 1 HW 20 DAS and were effective in reducing the weed dry weight at 60 DAS.

The highest grain yield of 1.40 t/ha was obtained under mechanical weeding 20 DAS *fb* 1 HW 40 DAS which was significantly similar to reduced spacing (20 cm) *fb* 1HW 20 DAS, two HW (20 & 40 DAS), crop residue mulch 6 t/ha *fb* 1HW 20 DAS and stale seedbed *fb* 1 HW 20 DAS.

Higher B:C was obtained under reduced spacing *fb* 1 HW (2.01) and mechanical weeding 20 DAS *fb* 1 HW 40 DAS (1.94).

Mechanical weeding 20 DAS *fb* 1 HW 40 DAS

Unweeded

UAS, Bengaluru

The finger millet (ML-365) was sown at a common spacing of 30 cm between the rows and 10 cm between the plants. At the time of sowing N equivalent compost *i.e* Vermicompost is applied of 5 kg per plot. Stale seed bed treatment was initiated 15 days prior to the sowing of crop. Mulching was done using crop residues (black gram pods husk) 6 t/ha at the time of sowing.

The predominant weed flora observed in the experimental field were among sedges (*Cyperus rotundus*), among grasses (*Digitaria marginata* and *Cynodon dactylon*) and among the Broad-leaved weeds (*Borreria hispida*, *Ageratum conyzoides*, *Commelina benghalensis* and *Cleome viscosa*) were dominant. Among the different category of weeds, the density of Broad leaved weeds was higher followed by sedges and grasses.

Among the non-chemical method of weed control Two hand weeding at 20 and 40 DAS recorded the highest WCE of 46.42% and 32.29% at 30 DAS and 60 DAS respectively followed by Crop residue mulch 6 t/ha *fb* 1 HW 20 DAS (33.99%) and Stale seedbed *fb* 1 HW 20 DAS (43.33%) at 30 DAS and even at latter stage of the crop. Two hand weeding at 20 and 40 DAS recorded the highest grain yield (1.54 t/ha) followed by Crop residue mulch 6 t/ha *fb* 1 HW 20 DAS (1.36 t/ha) and Stale seedbed *fb* 1 HW 20 DAS (1.27 t/ha).

The highest net return of (Rs. 27,020/ha) was obtained in crop residue mulch 6 t/ha *fb* 1 HW 20 DAS followed by two hand weeding at 20 DAS and 40 DAS (Rs. 28,120/ha) and reduced spacing (20 cm) *fb* 1 HW 20 DAS (Rs. 21,970/ha). Whereas, the B:C was higher in crop residue mulch 6 t/ha *fb* 1 HW 20 DAS (2.34) followed by two hand weeding at 20 and 40 DAS (2.09) and reduced spacing (20 cm) *fb* 1 HW 20 DAS (2.08).

Crop residue mulch 6 t/ha*fb* 1 HW 20 DAS

Two HW (20 and 40 DAS)

Weedy check

WP 1.3.3. Weed management in organically grown maize-wheat cropping system

Centre: CSKHPKV, Palampur

Treatments:

No.	Maize (*Kharif*)	Wheat (*Rabi*)
T_1	Hand weeding/hoeing (HW)	Hand weeding on 20 & 40 DAS
T_2	Stale seed bed + HW	Stale seed bed + HW
T_3	Raised stale seed bed + HW	Raised stale seed bed + HW
T_4	Mulch 5 t/ha + HW	Mulch 5 t/ha + HW
T_5	Stale seed bed + mulch 5 t/ha + HW	Stale seed bed + mulch 5 t/ha + HW
T_6	Raised stale seed bed + mulch@5t/ha + HW	Raised stale seed bed + mulch@5 t/ha + HW
T_7	Intercropping (soybean) + hoeing/HW	Intercropping (mustard) + hoeing/HW
T_8	Crop rotation (maize/soybean)	Wheat/sarson
T_9	Mulch + manual weeding *fb* relay crop of mustard (green)	Mulch + manual weeding *fb* summer crop of buckwheat
T_{10}	Mechanical weeding/weeding with hoes	Hoeing

Common organic practices [seed/seedling treatment with beejamrit, 30 kg/ha N equivalent dose in *Kharif* and 120 kg/ha in *Rabi* from sources like FYM/Vermicompost/other organic manures followed by three sprays of jeevamrit/ panchgavya/ amritpani/ vermivash at the vegetative stage of the crop] will be followed for raising of crops along with imposed treatments including the check.

Stellaria media (28%), *Tulipa asiatica* (25%), *Spergula arvensis* (13%), *Phalaris minor* (6%), *Poa annua* (5%) and *Ranunculus arvensis* (5%) were the major weeds during *Rabi* 2022-23.

During *Kharif* 2023, the major weeds were *Cyperus* sp (28%), *Ageratum* sp (22%), *Echinochloa* sp (20%), *Polygonum alatum* (6%), *Digitaria sanguinalis* (%), *Trifolium repens* (5%), *Eleusine indica* (4%), *Commelina* sp (3%), and *Panicum dichotomiflorum* (3%).

During *Rabi* 2022-23, weed control treatments significantly influenced the count of *Stellaria media* at 30 DAS with maximum population under SSB + mulch + HW and lowest under hoeing being at par with intensive cropping + mulch + HW and RSSB + mulch + HW. Mulch + HW had the significantly lowest count of *Tulipa asiatica* at 90 DAS followed by crop rotation + HW. There was a significant difference in population of *Tulipa asiatica* among different treatments at 90 DAS.

Weed count in maize during *Kharif* 2023, was diverse. Intensive cropping, crop rotation, RSSB+hoeing and RSSB+mulch resulted in significantly higher maize equivalent yield over the mechanical check. Highest net returns were accrued in the intensive cropping treatment because of more crops raised in this treatment. It was followed by RSSB+mulch and RSSB+hoeing. Highest B:C was in the intensive cropping followed by intercropping.

WP 1.3.6 Organic weed management practices for coconut plantations

Centre: KAU, Thrissur

Treatments

T_1 - *In-situ* green manuring with *dhaincha* in the interspaces (July-August sowing and Oct-Nov ploughing)

T_2 - *In-situ* green manuring with cowpea in the interspaces (July-August sowing and Oct-Nov ploughing)

T_3 - *In-situ* green manuring with horsegram in the interspaces (July-August sowing and Oct-Nov ploughing)

T_4 - Mulching interspaces of coconut trees using Oushadhi waste @ 20 t/ha (by-product of Ayurveda industry)

T_5 - Ploughing alone (June & Oct-Nov)

T_6 - Intercropping with turmeric

T_7 - Control

A 20-year-old coconut plantation with a spacing of 7.5 m X 7.5 m was selected for the study. The design was RBD with four replications. Interspaces between eight coconut palms were taken as one treatment replication. The first-year experiment was started in August 2022. After ploughing the interspaces using a cultivator attached to the tractor, sowing of dhaincha, cowpea, and horsegram and planting turmeric was undertaken. Oushadhi waste collected from the Ayurveda industry was spread as a thin layer in the interspaces.

Soil weed seed bank assessment

The weed seed bank study shows that the soil of the experimental site had good weed seed density, and grasses were the dominant flora, followed by broadleaf weeds **(Table 1.3.1)**. Sedges were not present. Also, there was a high seed load on the surface soil layer compared to the subsurface layer. There was a decline in germination percentage in the case of both soil layers with the advancement of time, which shows that the weed seed bank was depleted by this time.

On average, 60 weed seedlings emerged by the 30th day from the surface soil layer and 23 numbers from the subsurface layer. Grassy weeds constituted 66% of the total weed population.

Table 1.3.1. Count of weed seedlings germinated from surface and subsurface soil layers

Type of weed	Surface soil layer (0-15 cm)			Subsurface soil layer (15-30 cm)		
	0-15 days	15-30 days	Total	0-15 days	15-30 days	Total
Broadleaf weeds	12	8	20	4	4	8
Grasses	22	18	40	10	5	15
Total	34	26	60	14	9	23

Weed flora in the field

During the first year, weed flora constituted mainly of grasses followed by broadleaf weeds. In both soil layers, the constitution of the weed spectrum remained the same. The broad-leaved weeds observed were *Celosia argentina*, *Borreria hispida,* and *Cleome* spp, *Borreria* being the dominant one. Major grasses were *Panicum maximum* and *Pennisetum pedicellatum*. However, by the second year, there was a shift in weed flora in legume intercropped fields, where broadleaf weeds dominated followed by grassy weeds. This shift was not seen in unweeded check.

A comparison of weed density in different treatments during the first year showed that in

treatments in-situ green manuring using horse gram and mulching with Oushadhi waste, no weeds were present at 2 MAT. *In-situ* green manuring with dhaincha and cowpea recorded 7.64 and 6.37 weeds/m^2 respectively. In plots intercropped with turmeric, the weed population was very high compared to the legume intercropped plots with a weed density of 62.37 weeds/m^2. The highest total number of weeds was recorded from unweeded control (268.61 weeds/m^2), followed by ploughing alone (115.64 weeds/m^2) which were statistically different. So, ploughing alone could considerably reduce the weed population to the extent of 43% over the unploughed check. The same trend was noticed when observed at 4 MAT. By 6 MAT broadleaf weeds constituted the major flora. However, due to the scarcity of rainfall, the weed density decreased.

In the second year, a decrease in weed density was observed. The population of broad-leaved weeds was higher compared to grasses. The same trend as in the first year was followed in all the treatments.

Ploughing the interspaces was comparatively an ineffective practice for weed control compared to legume intercropping, with a higher weed density. However, compared to unweeded check this treatment was statistically superior. By six months the reduction in weed population was almost 60% in 2022 and 40% in 2023.

During both years weed dry weight was also recorded at two-month intervals and here also same trend as that of weed count was observed. In all legume intercropping treatments, weed dry matter production was statistically comparable, and on average the reduction in weed dry matter accumulation was 96% over unweeded control, indicating the effectiveness of cover cropping in smothering weeds.

Soil chemical analysis

Soil samples were collected at the end of first and second-year experiments in December 2022 and 2023. Data are furnished below.

The pH of the soil varied from 4.69 to 5.99 and EC varied from 35 to 210 µS/m. The highest pH and EC were registered in oushadhi waste mulched field.

The total organic matter, as well as organic carbon content, were higher in legume intercropping as well as organic waste mulching compared to ploughing alone and UWC **(Fig.1.3.2)**. The organic matter content was higher in horse gram (T3) and oushadhi (T4) with about 4% increase over UWC.

The heavy metal status of the soil indicated below the detectable level (BDL) of Ni and Cd before the experiment. Though a higher content of Pb was observed in oushadhi mulched plots in the first year (15.23 mg/kg), the content was lowered to 5.3 mg/kg by the second year.

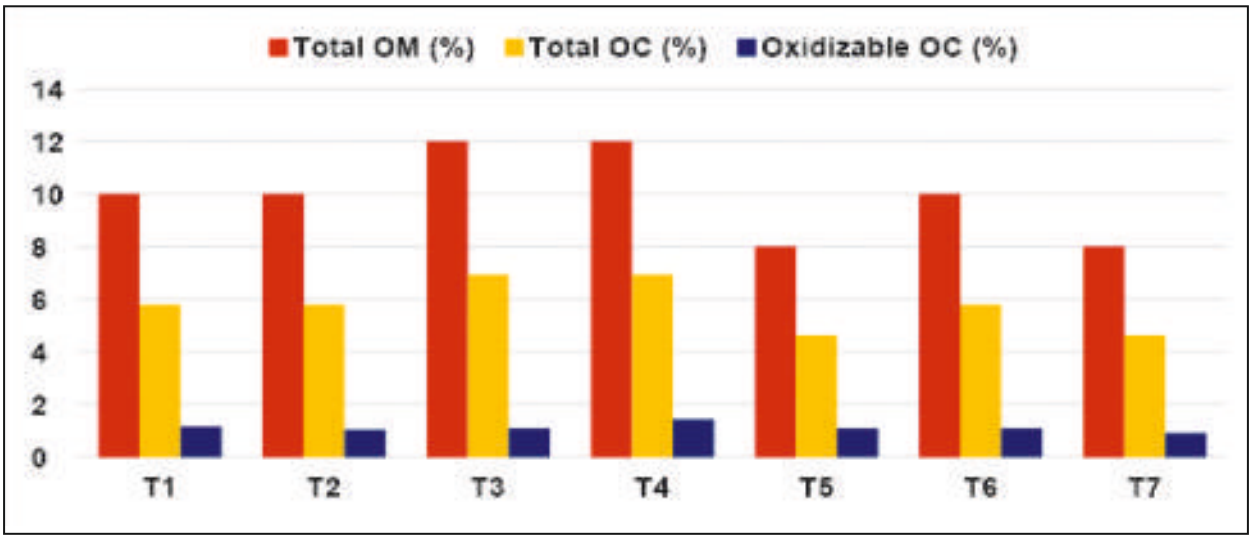


Fig.1.3.2: Effect of weed management practices on total organic matter, organic carbon and oxidizable organic carbon

Soil microbiological analysis

Enhanced microbial biomass carbon, dehydrogenase activity, as well as acid phosphatase activity, were observed in plots where intercropping practices or oushadhi organic waste application were followed. Also, in the second year of treatment application, a remarkable increase in these parameters could be observed indicating improvement in soil health.

Soil microbial count showed a marked increase in the population of fungi and bacteria in legume intercropped and organic mulched plots. Fungi dominated the microbial population, followed by bacteria. Actinomycetes population was lower and no definite trend could be observed with treatments.

General field view

Weed infestation in the ploughed field at 2 months after ploughing

Mulching interspaces of coconut trees using Oushadhi waste

WP 1.3.8. Weed management in tomato-beetroot-watermelon cropping system under organic agriculture

Centre : PJTSAU, Hyderabad

Treatments:

T. No	*Kharif* (tomato)	*Rabi* (beet root)	*Summer* (water melon)
T_1	Live mulch with *dhiancha* and incorporation at 30 DAT	Groundnut shell mulch 5 t/ha	Groundnut shell mulch 5 t/ha
T_2	Stale seed bed *fb* HW at 20 & 40 DAT	Rice husk mulch 3 t/ha	Rice husk mulch 3 t/ha
T_3	Poly mulch + intra row manualweeding at 30 DAT	Poly mulch + intra row Hand Weeding at 30 DAS	Poly mulch + intra row Hand Weeding at 30 DAS
T_4	Rice straw mulch 5 t/ha + intra row HW at 30 DAT	Rice straw mulch 5 t/ha+ intra row HW at 30 DAS	Rice straw mulch 5 t/ha+ intra row HW at 30 DAS
T_5	Hoeing twice at 20&40 DAT+intra row HW	Hoeing twice at 15 & 30 DAS +intra row HW	Hoeing twice at 15 & 30 DAS +intra row HW
T_6	Intercrop green leaf vegetable *fb* HW at 40 DAT	Intercrop green leaf vegetable *fb* HW at 40 DAS	Intercrop green leaf vegetable *fb* HW at 40 DAS
T_7	Unweeded control	Unweeded control	Unweeded control

Beetroot

Highest weed control efficiency was found with poly mulch + intra row HW at 30 DAS both at 30 and 60 DAS. It was followed by paddy straw mulch + intra row HW at 30 DAS.

Among the weed management treatments, higher yield of beetroot was recorded with poly mulch + intra row HW at 30 DAS which was significantly superior to all the other treatments. The next best treatment was paddy straw mulch + intra row HW at 30 DAS followed by groundnut shell mulch 5 t/ha.

Even though, the yield of beetroot was high in poly mulch treatment, due to additional yield of geen leafy vegetable in intercropping treatment, the gross returns, net returns and B-C ratio were higher in Intercrop green leaf vegetable *fb* HW at 40 DAT and it was followed by poly mulch + intra row HW at 30 DAS, paddy straw mulch + intra row HW at 30 DAS and groundnut shell mulch 5 t/ha.

Watermelon

Phytotoxicity symptoms on watermelon:

No phytotoxicity symptoms were observed on watermelon due to any of the weed management practices.

Highest and consistent weed control efficiency was found with poly mulch + intra row HW followed by paddy straw mulch + intra row HW at 30 DAS.

Among the weed management treatments, higher yield of watermelon was recorded with poly mulch + intra row HW at 30 DAS which was significantly superior to all the other treatments. The next best treatment was groundnut shell mulch 5 t/ha and it was at par with paddy straw mulch + intra row HW at 30 DAS.

Eventhough, the yield of watermelon was high in poly mulch treatment, due to additional yield of geen leafy vegetable in intercropping treatment, the gross returns, net returns and B-C ratio were similar in intercrop green leaf vegetable *fb* HW at 40 DAT to that of poly mulch + intra row HW at 30 DAS and it was follwed by paddy straw mulch + intra row HW at 30 DAS and groundnut shell mulch 5 t/ha.

Tomato Equivalent Yield (TEY) of the cropping system:

Highest TEY was recorded in the treatment, poly mulch + intra row HW at 30 DAS applied for all the three crops in the sequence which was significantly superior over the rest of the treatments. The second-best treatment was intercropping treatment and rice straw mulch 5 t/ha + intra-row HW at 30 DAS.

Tomato-beetroot-watermelon cropping system economics:

Highest gross returns, net returns and B-C ratio were recorded in poly mulch + intra row HW at 30 DAS applied for all the three crops in the sequence which was followed by intercrop green leaf vegetable *fb* HW at 40 DAT and rice straw mulch 5 t/ha + intra row HW at 30 DAS.

Tomato

Weed flora: The weed flora observed during crop growing season consists of: *Cyperus rotundus*, *Parthenium hysterophorus*, *Alternanthera sessilis, Digera arvensis, Amaranthus viridis, Amaranthus polygamus, Aacalypha indica, Dactyloctenium aegyptium, Portulaca oleracea, Oldenlandia corymbosa, Ocimum tenuiflorum and Euphorbia geniculata at various stages of observation.*

The weed control efficiency at 30 DAT was the highest with with stale seed bed *fb* HW at 20 and 40 DAT which was comparable with poly mulch + intra row HW at 30 DAT and rice straw mulch 5 t/ha + intra row HW at 30 DAT. At 60 DAT also, poly mulch or rice straw mulch

or hoeing supplemeted with intra row HW recorded comparable WCE and superior to *dhaincha* live mulch or stale seed bed or intercropping green leaf vegetable.

Among the treatments, highest tomato yield was recorded in polymulch + intra row HW at 30 DAT which was followed by rice straw mulch 5t/ha + intra row HW at 30 DAT and Stale seed bed *fb* HW at 20 & 40 DAT. In the remaining treatments, the yield levels were reduced significantly.

Based on the first-year experimental results, it can be concluded that polymulch + intra row HW at 30 DATor rice straw mulch 5 t/ha + intra row HW at 30 DAT or stale seed bed *fb* HW at 20 & 40 DAT were found to be effective non-chemical weed control methods and realized higher tomato yield in tomato-beet root-water melon cropping system.

WP 1.3.9 Non-chemical weed management in Brinjal

Centre: TNAU, Coimbatore

Among the broad-leaved weeds, *Trianthema portulacastrum, Digeria arvensis, Parthenium hysterophorus, Amaranthus* spp. were predominant and *Dactyloctenium aegyptium, Setaria verticillata, Cynodon dactylon* were dominant species in grasses.

At 20 DAT, lower weed density and weed dry weight were recorded with weed mulch 5 t/ha *fb* 1 HW at 40 DAT (3.87/m^2 and 2.38 g/m^2, respectively) and it was on par with biodegradable polythene mulch (3.88/m^2 and 2.39 g/m^2, respectively). At 40 DAT and 60 DAT also, the similar trend was observed with weed density, dry weight and weed control efficiency. Broad-leaved weeds were dominant in all the treatments at 40 & 60 DAT. This was followed by grasses and sedges.

The crop is in flowering and fruiting stage. The trial is in progress.

WP 1.4 Management of parasitic weeds

WP 1.4.1. Management of *Orobanche* in brinjal and tomato

Network centres: OUAT Bhubaneswar, MPUAT Udaipur, UAS Dharwad

Treatments:

Sr. No.	Treatment
1	Soil solarization
2	Oxyfluorfen 50 g/ha at sowing *fb* sulfosulfuron 25 g/ha at 25 DAT
3	Pendimethalin 1000 g/ha at sowing *fb* sulfosulfuron 25 g/ha at 25 DAT
4	Ethoxysulfuron 25 and 50 g/ha at 25 and 50 DAT
5	Sulfosulfuron 25 g/ha at 25 DAT *fb* 25 g/ha at 50 DAT
6	Halosulfuron 67.5 g/ha 25 DAT *fb* 67.5 g/ha at 50 DAT
7	Neem cake 200 kg/ha *fb* pendimethalin 1000 g/ha as pre em.
8	Neem cake 200 kg/ha at transplanting *fb* glyphosate at 15 and 15 g/ha at 25 DAP & 50 DAP
9	Neem cake 200 kg/ha *fb* ethoxysulfuron 25 and 50 g/ha at 25 and 50 DAT
10	Neem cake 200 kg/ha *fb* sulfosulfuron 25 g/ha at 25 DAT *fb* 25 g/ha at 50 DAT
11	UAS- D AMF consortium*
12	Untreated check

Note: * Pre colonization of the brinjal/tomato seedlings in the nursery beds with UAS-D AMF consortia (@ 2 kg of UASDAMF consortium /M2).

*Soil application of UASDAMF consortium (8 kg/acre mixed with 200 kg Vermicompost) at the time of planting pre-colonized seedlings. Neem cake 200 kg/ha should be applied at the root zone using the plant hole application technique. The consortium developed by UAS-D shall be distributed to all network centres

If *Orobanche* is not a problem at the research farm of the centre, they should take it in OFR mode with four treatments *viz.* i. suitable chemical control, ii. Neem cake 200 kg/ha using plant hole technique, iii. UASDAMF consortium, and iv. weedy check)

OUAT, Bhubaneswar

Orobanche aegyptica Sporadic incidence of *Orobanche* was observed in brinjal and tomato crops under the potential vegetable tracts of Cuttack and Khurda districts alongside of the river *etc.* of the Mahanadi. In managing *Orobanche*, the application of neem cake 200 kg/ha *fb* ethoxysulfuron 25 g/ha each at 25 and 50 DAT was found the best treatment in managing the *Orobanche* infestation in brinjal.

MPUAT, Udaipur

The infestation of *Orobanche* in tomato and brinjal was not observed in experimental fields. However, eight OFR on the Management of *Orobanchae* in tomato and brinjal through herbicide were conducted at Kantoda village of tehsil- Sarada. Application of ethoxysulfuron 25 g/ha at 25 DAT *fb* 50 g/ha at 50 DAT was effective in reducing the *Orobanche* infestation and increasing brinjal and tomato yield over neem cake at 200 kg/ha and weedy check.

UAS, Dharwad

This experiment was not implemented

WP 1.4.2. Management of *Orobanche* in mustard

Centre: CCSHAU, Hisar

No *Orobanche* stalk emerged up to 90 DAS. However, at the time of harvesting the infestation of *Orobanche* occurred affecting the crop yield. Application of different formulations resulted in significantly lower *Orobanche* stalk as compared to the control treatment. Application of glyphosate formulation with ammonium sulphate have some phyto-toxicity on the crop resulting in some yield loss as compared to alone application and application of glyphosate with nano-urea. Application of glyphosate by mixing with nano urea not significantly influenced the seed yield of mustard. Application of glyphosate with ammonium sulphate has phyto-toxicity on the crop.

WP 1.4.3. Management of *Striga* in sugarcane

Network centres: UAS Dharwad, TNAU Coimbatore

Treatments:

Sr.No.	Treatment
T_1	2,4-D Na 2.0 kg/ha + Metribuzine 1.0 kg/ha at the time of *Striga* emergence
T_2	Atrazine 1.0 kg/ha on 3 DAP + HW on 45 DAP + earthing up on 60 DAP + POE 2,4-D Na salt 5 g/L + urea 20 g/L on 90 DAP *fb* trash mulching at 5 t/ha on 120 DAP
T_3	UAS-D AMF consortium*
T_4	Untreated check

Note: *Soil application of UASDAMF consortia at the time of planting pre-colonized seedlings (8kg/acre mixed with 200 kgs Vermicompost)

UAS, Dharwad

Striga in sugarcane (Ongoing):

At 90 DAS, the treatment receiving UASD-AMF consortium recorded the highest plant height, number of tillers, relative chlorophyll content, dehydrogenase activity, Phosphatase activity, while reducing the number of *Striga* emergence (180.20 cm,6.00 per meter length, 33.52 (SPAD),40.04 µg TPF formed g-1 soil d^{-1},33.12 µg pnp released g^{-1} soil $h^{-1}$and 1.20 per meter length respectively) **(Table 1.4.1).**

Table 1.4.1 Interactive effect of herbicide molecules and UASD AM consortia on growth, physiological, soil enzyme activity and *Striga* parameter

	Treatments	Plant height (cm)	Number of tillers per meter length	SPAD	Dehydrogenase (µg TPF formed g^{-1} soil d^{-1})	Phosphatase (µg pnp released g^{-1} soil h^{-1})	Number of *Striga* per meter length
T_1	2,4-D Na 2.0 kg/ha + Metribuzine 1.0 kg/ha at the time of *Striga* emergence Atrazine 1.0 kg/ha on 3 DAP + HW on 45 DAP + earthing up on 60 DAP +	167.80	4.60	33.30	20.97	28.04	3.00
T_2	POE 2,4-D Na salt 5 g/L + urea 20 g/L on 90 DAP *fb* trash mulching at 5 t/ha on 120 DAP	174.60	4.80	31.76	22.14	31.98	3.80
T_3	UAS-D AMF consortium	180.20	6.00	33.52	40.04	33.12	1.20
T_4	Untreated check	152.00	4.20	27.32	19.24	22.88	6.20
T_5	UAS-D AMF consortium*+ Atrazine 1.0 kg/ha on 3 DAP + HW on 45 DAP + earthing up on 60 DAP + POE 2,4-D Na salt 5 g/L + urea 20 g/L on 90 DAP *fb* trash mulching at 5 t/ha on 120 DAP	177.20	5.80	32.40	31.68	29.86	2.20
	SEm.	**3.21**	**0.57**	**1.42**	**0.680**	0.063	**0.95**
	LSD (p=0.05)	**9.72**	**N/S**	**4.31**	**3.978**	5.000	**2.86**

Atrazine 1.0 kg/ha on 3 DAP + HW on 45 DAP + earthing up on 60 DAP + POE 2,4-D Na salt 5 g/L + urea 20 g/L on 90 DAP fo trash mulching at 5 t/ha on 120 DAP

Untreated Check

T_5: Atrazine 1.0 kg/ha on 3 DAP + UAS-D AMF consortium

TNAU, Coimbatore

Lesser emergence of *Striga* was observed in the application of UAS-D AMF Consortium 8 kg/acre (0.50 no./30 m^2) followed by Atrazine 1.0 kg/ha on 3 DAP + HW on 45 DAP + earthing up on 60 DAP + POE 2,4-D Na salt 5g/L + urea 20 g/L on 90 DAP *fb* trash mulching at 5 t/ha on 120 DAP (0.75 no./ 30 m^2). Higher number of striga population was observed in unweeded check (3.00 no./30 m^2) **(Table 1.4.2)**. At 90 DAP, lesser Striga biomass was observed in the application of UAS-D AMF Consortium 8 kg/acre (1.22 g/30m^2) followed by Atrazine 1.0 kg/ha on 3 DAP + HW on 45 DAP + earthing up on 60 DAP + POE 2,4-D Na salt 5g/L + urea 20 g/L on 90 DAP *fb* trash mulching at 5 t/ha on 120 DAP (1.38 g/30m^2).

Table 1.4.2 Effect of weed management practices on plant height of sugarcane, density and dry weight of Striga at 90 and 120 DAP

Treatments		Plant height (cm) of sugarcane		Observations on *Striga*			
				Density (No./30 m^2)		Dry weight (g/ 30 m^2)	
		90 DAP	120 DAP	90 DAP	120 DAP	90 DAP	120 DAP
T_1	2,4-D Na 2.0 kg/ha + Metribuzin 1.0 kg/ha at the time of striga emergence	130.7	151.4	2.00	2.50	1.53	1.62
T_2	Atrazine 1.0 kg/ha on 3 DAP + HW on 45 DAP + earthing up on 60 DAP + POE 2,4-D Na salt 5g/L + urea 20 g/L on 90 DAP *fb* trash mulching at 5 t/ha on 120 DAP	137.6	153.7	0.75	1.25	1.38	1.43
T_3	UAS-D AMF Consortium 8 kg/ac	146.2	158.6	0.50	1.00	1.22	1.36
T_4	Untreated check	124.2	145.5	3.00	3.75	3.46	3.67
	S.Ed	1.1	2.6	0.03	0.36	0.09	0.04
	LSD (P=0.05)	2.6	5.8	0.06	0.88	0.22	0.09

WP-1.4.4. Management of *Cuscuta* in onion and pulses (blackgram, greengram and cowpea)

Centre: UAS, Bengaluru

This year also any incidence of *Cuscuta* was not observed in farmer's field. Hence, trial was not conducted.

WP-1.4.5. Management of *Cuscuta* in berseem fodder crop

Centre: RVSKV, Gwalior

The early post- emergence application of pendimethalin 500 g/ha at 10 DAS significantly suppressed the *Cuscuta* emergence up to 90 DAS. Whereas, the imazethapyr 40 g/ha after first cut *fb* imazethapyr 50 g/ha after last cut provided the maximum fodder yield (70.15 t/ha) and seed yield (486 kg/ha) with BC ratio (4.60) which was closely *fb* imazethapyr 40 g/ha after 1st cut and imazethapyr 40 g/ha after last cut.

WP 1.4.6. Management of *Cuscuta* in Lucerne

Centre: AAU Anand

Some phytotoxicity of applied herbicides was observed on lucerne crop and initially plant growth was affected by the application of pendimethalin 30% EC 500 and 750 g/ha at 10 DAS and pendimethalin 30% + imazethapyr 2% EC (PM) 640 and 800 g/ha compared to other herbicides but recovered after 14 DAHA.

Application of pendimethalin 30% EC 500 and 750 g/ha at 10 DAS and pendimethalin 30%+imazethapyr 2% EC 640 and 800 g/ha at 10 DAS

were found effective for *Cuscuta* management in lucerne in which no emergence of *Cuscuta* was recorded even after 60 DAS.

Significantly higher green fodder yield at 75 DAS was recorded in pendimethalin 30%+imazethapyr 2% EC 640 g/ha at 10 DAS but remained at par with pendimethalin 30%+imazethapyr 2% EC 640 g/ha at 10 DAS, pendimethalin 30% EC 500 g/ha at 10 DAS and pendimethalin 30% EC 750 g/ha at 10 DAS.

WP-1.4.7. Management of *Loranthus*

Centre: AAU Jorhat

Loranthus is a genus of leathery-leaved parasitic plants that grow on the branches of broadleaf woody trees like tea, rubber, citrus, mango, apple, oak and other woody trees. Once the Loranthus is heavily infested then it is difficult to control. Therefore, at the initial stage of infestation removal of the infected portion is the suitable method to control it. Therefore, an experiment was started on 22.12.2023 in a tea garden kept unpruned for seed production with the following treatments:

Treatments:

T_1: Cutting down the affected branch of the host plant

T_2: Cutting down the affected branch of host plants f.b. application of bordeaux paste

T_3: Application of 2,4-D 1% around the infected branch with cotton cloth strip soaked in herbicide at the point of attachment to the host after removing the outer skin to about 2 cm length on the pest trunk

T_4: Application of $CuSO_4$ on host plant with cotton cloth strip soaked in herbicide at the point of attachment to the host after removing the outer skin to about 2 cm length on the pest trunk

T_5: Spreading of metribuzin 0.10 % solution on the trunk of the host plan on the pest trunk

Effective control was observed with application of 2,4-D 1% around the infected branch with cotton cloth strip soaked in herbicide at the point of attachment to the host plant (T_3) and on the pest trunk (T_4) after removing the outer skin to about 2 cm length

WP 1.4.8 Studies on response of hemi parasitic fern *Pyrrosia* (Dragon scale fern) on trees/nutmeg plantations to various weed management methods

Centre: KAU, Thrissur

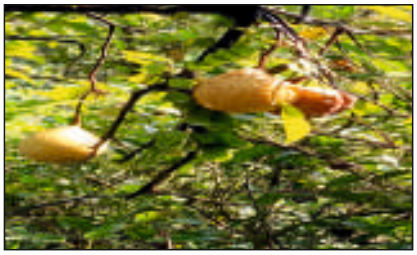
Physical removal was very difficult, time-consuming, and tedious due to closely adhering the roots of the fern to the host, it is also not a viable option when infestation is on small branches, and pruning the branches only can help in such situations.

Observations recorded one month after treatment application on *Pyrossia* and nutmeg

Treatment	Observations
Physical control	Not effective
2,4-D sodium salt 1 kg/ha + Urea 1%	Not effective
Copper sulphate 5%	Not effective
Glufosinate ammonium 0.50 kg/ha	Effective, but leaf fall and drying in nutmeg
Ethrel (Ethephone 39% SL) 15 & 25 ml/L	Not effective, but leaf fall in nutmeg
Glyphosate 1 kg/ha	Effective, leaf fall and drying in nutmeg
Unsprayed check	---

The pre-emergent herbicides tested along with 1% urea and sticker @ 2 ml/L and their effect on pyrossia and its host nutmeg

Treatment	Observations
Pretilachlor 50 EC 3 ml + Urea 1%	Slightly effective but leaf fall in nutmeg
Oxyfluorfen 23.5 EC 1.5 ml + Urea 1%	100% Effective but leaf fall in nutmeg
Butachlor 50 EC 3 ml + Urea 1%	100% Effective but leaf fall in nutmeg
Metribuzin 70 WP 5 g + Urea 1%	100% effective but leaf fall, bark drying and scaling in nutmeg
Urea 1%	Not effective
Unsprayed check	---



Pyrossia infested nutmeg tree showing wilting of twigs and drying of fruits

Fertile and sterile fronds

WP-1.5 Management of herbicide resistance in weeds

Guidelines to all centres:

- All centers need to be more vigilant regarding the development of herbicide resistance in their respective area
- Conduct systematic survey and collect sufficient population of reported resistance and then go for further study on herbicide resistance.
- Collect samples/seeds from the area where the herbicide is not yet applied so as to establish the resistance

WP-1.5.1 Management of resistant *Phalaris minor* and other weeds with new herbicide combination

Network centres: PAU Ludhiana, CCSHAU Hisar, SKUAST Jammu, GBPUAT Pantnagar

Treatments:

Tillage and residue management

1. Conventional tillage (without residue)

2. Zero till with residue retention on surface (Happy Seeder)

3. Conventional tillage with residue incorporation (Super Seeder)

Weed management

1. Unsprayed control

2. Pyroxasulfone at 100 g + pendimethalin at 800 g/ha (Pre-emergence)

3. Pyroxasulfone at 127.5 g + metribuzin at 150 g/ha (Pre-emergence)

4. Pinoxaden at 50 g + metribuzin at 175 g/ha (Post emergence)

PAU, Ludhiana

Phalaris minor, Rumex dentatus, Medicago denticulata were the major weeds, other weeds included *Anagallis arvensis, Chenopodium album* and *Coronopus didymus*. Among tillage and residue management, ZT (+R) had the lowest weed density as well as biomass. In case of CT, CT (-R) had higher weed density than CT (+R) before first irrigation while the reverse was true at later stages. The grain yield and yield attributes among tillage and residue management treatments were at par.

Among weed control, tank-mix of pyroxasulfone with pendimethalin/ metribuzin recorded effective control of *P. minor* and *R. dentatus* while tank-mix of pinoxaden with metribuzin provided effective control of *M. denticulate* also, along with all other weeds. All herbicidal treatments recorded similar wheat grain yield and attributes which were significantly higher than unsprayed control. (Table 1.5.1).

Table 1.5.1 Interaction effects of tillage, residue management and weed control on *Phalaris minor* density at 50 DAS in wheat (2022-23)

Treatments	*Phalaris minor* density (No./m²)			
	Unsprayed Control	Pyroxasulfone + pendimethalin	Pyroxasulfone + metribuzin	Pinoxaden + metribuzin
CT (-R)	3.16 (9.3)	2.37 (4.6)	1.00 (0)	1.00 (0)
ZT (+R)	2.07 (3.3)	1.00 (0)	1.00 (0)	1.4 (1.3)
CT (+R)	4.02 (15.3)	1.00 (0)	2.76 (6.7)	1.48 (1.3)
LSD (p=0.05)	0.61			

Data subjected to square root transformation. Figures in parentheses are means of original values.

CCSHAU, Hisar

Tillage, residue management treatments failed to affect weed density at 75 DAS in wheat. Minimum weed density was observed for the treatment pinoxaden at 50 g + metribuzin at 175 g/ha (post emergence), which was at par with pyroxasulfone at 100 g + pendimethalin at 800 g/ha (pre-emergence) except for the density of *M. denticulata and C. didymus*. Similarly, higher grain and straw yield was recorded with post emergence application of pinoxaden at 50 g + metribuzin at 175 g/ha (5.5; 6.4 t/ha), which was statistically at par with pre-emergence application of pyroxasulfone at 100 g + pendimethalin at 800 g/ha (5.4; 6.3) followed by pre-emergence application of pyroxasulfone at 127.5 g + metribuzin at 150 g/ha (5.2; 6.3 t/ha). Among tillage and residue management, sowing of wheat with Happy Seeder under Zero till with residue retention on surface resulted higher grain yield (5.4; 6.3 t/ha), while all the treatments were statistically at par with each other.

SKUAST, Jammu

The experimental field was dominated by *Phalaris minor, Anagalis arvensis, Rumex dentatus* and *Ranuculus arvensis* at 25 DAS, 50 DAS and at harvest. The Conventional tillage with residue incorporation (Super seeder) recorded lowest weed density and weed biomass as compare to other tillage and residue management treatments at 25 DAS, 50 DAS and at harvest. Amongst all weed control practices, application of pyroxasulfone 100 g + pendimethalin 800 g/ha (PE) recorded significantly lower weed density and weed biomass of broad-leaved weeds followed by pyroxasulfone 127.5 g + metribuzin 150 g/ha (PE). However, pinoxaden 50 g + metribuzin 175 g/ha (PoE) significantly reduced the density and biomass of *P. minor* at 50 DAS and at harvest as compared to other herbicides.

The tillage and residue management practices were non-significant for yield, yield attributes and net returns. Among the weed management practices, the significantly highest wheat yield attributes, yield and net returns were recorded by pyroxasulfone 100 g + pendimethalin 800 g/ha (PE) followed by pyroxasulfone 127.5 g + metribuzin 150 g/ha (PE).

GBPUAT, Pantnagar

The experiment was initiated during *Rabi* 2022. At different stages 25 DAS, 50 DAS and at harvest, lowest total weed dry weight and highest weed control efficiency (67.1%) was recorded under conventional tillage (without residue) among the tillage methods. Among weed management treatments pyroxasulfone at 127.5 g + metribuzin at 150 g/ha (PE) treatments recorded significantly lowest weed dry weight at different stages and highest weed control efficiency (80.0%).

All yield attributing characters and yield of wheat were non-significantly affected due to different establishment methods, except grains/panicles.

Among different establishment methods, the highest net return (Rs.75750.0/ha) and benefit-cost ratio (2.87) were recorded with conventional tillage (without residue) and zero till with residue retention on surface (Happy Seeder) respectively. Among weed management treatments, pinoxaden at 50 g + metribuzin at 175 g/ha (PoE) recorded the highest net return (Rs. 89032.0/ha) and benefit-cost ratio (3.14).

WP-1.5.2 Management of resistance developed in *Cyperus difformis* against Bispiribac Sodium

Centre: IGKV Raipur

The density of *Cyperus difformis* was lesser under pyrazosulfuron 20 g/ha PE *fb* penoxsulam 22.5 g/ha 20 DAT as compared to pyrazosulfuron 20 g/ha PE and bispyribac Na 25 g/ha 20 DAT at 25 and 50 DAT. *Cyperus difformis* contributed almost 40 % of total weed density at 50 DAT in the plots where bispyribac Na 25 g/ha 20 DAT was used. Similar trend was observed in weed biomass at 25 and 50 DAT and at harvest Highest weed control efficiency of 97.97% **(Table 1.5.2)** at 50 DAT and grain yield (6.19 t/ha) was recorded under weed free treatment with 3 HW 20, 40 and 60 DAT while,

pyrazosulfuron 20 g/ha PE *fb* penoxsulam 22.5 g/ha 20 DAT found to be best option to reduce the weeds with higher WCE, highest plant height (112.63 cm), number ot effective tillers, comparable grain yield (5.66 t/ha) and B:C (3.50) among three chemical WM options.

Table 1.5.2 Weed control efficiency at 25 DAT, 50 DAT and at harvest as influenced by different weed management practices for control of resistant *Cyperus difformis*

Treatment	Weed Control Efficiency (%)		
	25 DAT	50 DAT	At harvest
Pyrazosulfuron 20 g/ha PE	47.38	45.18	19.15
Bispyribac Na 25 g/ha 20 DAT	25.02	61.61	31.68
Pyrazosulfuron 20 g/ha PE *fb* Penoxsulam 22.5 g/ha 20 DAT	62.15	76.08	62.55
Weed free, 3 HW 20, 40 and 60 DAT	94.54	97.97	78.93
Unweeded control	-	-	-

WP 1.5. 4 Bioassay study for *P. minor* resistance (Pot-culture)

Centre: SKUAST, Jammu

Pinoxaden, Mesosulfuron+ iodosulfuron and, sulfosulfuron, Fenoxaprop caused satisfactory control of all *P. minor* populations at recommended dose (x) as well as 2x. At recommended dose of clodinafop exhibited satisfactory control of all biotype except one biotype (P7). This indicated that clodinafop showed resistance in one biotype.

WP 2. Management of weeds in non-cropped and aquatic areas

WP 2.1. Biology of some invasive weeds under changing scenario

Centre: AAU, Jorhat

***Chromolaena odorata* (Asteraceae): Terrestrial Weed**

1. Golaghat district:

Geographic location: 25°50' to 26°47' N lat. & 93°16' to 94°10' E long. (Map. 2.1.1)

Altitude: 100 m from MSL.

Total area: 3502 sq.km.

Forest area: 1039.27 sq.km.

Chromolaena Infested area in 2023: 20200^{+} ha

Chromolaena Infested area in 2013: 15782 ha

Changes recorded: Nearly 28% area increase since 2013

Affected species: Most of the native and resident plants of upland & marshy situations

2. Charaideo district:

Geographic location: 26°55' to 27°08' N lat. & 94°47' to 95°22' E long. (Map 2.1.1)

Altitude: 89.6 m from MSL.

Total area: 1069.15 sq. km.

Forest area: 143.8 sq.km.

Chromolaena Infested area in 2023: 236^{+} sq.km

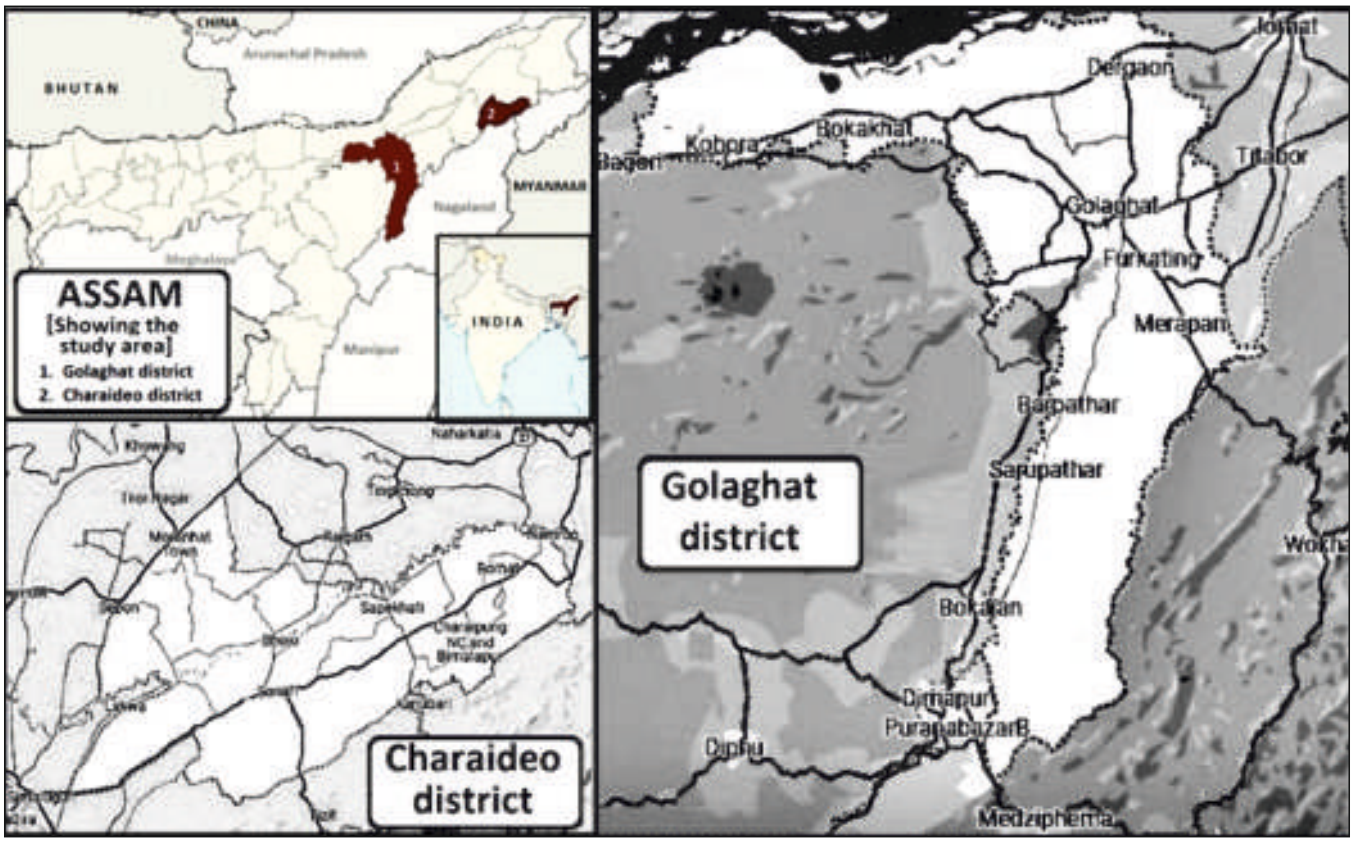


Fig. 2.1.1. Map of Assam, Charaideo district and Golaghat district, where the study of *Chomolaena* infestation was conducted during 2023

- *Chromolaena odorata* is an invasive environmental weed in Assam; it replaces majority of resident plant species in this area of infestation, which resulted in severe damage to the biodiversity pool by depleting food resources and shelter places and thus ultimately disrupted the niches for primary consumers in the food chains of grasslands and herbaceous vegetation.
- *Chromolaena odorata* could be easily controlled by foliar application of glyphosate, 2,4-D and metribuzin, the commonly used herbicides in the study area, however, reluctance to control the weed in public places caused severe infestation, especially in upland situations.
- The newly constituted Charaideo district was found to be rather severely affected by *Chromolaena* infestation, which was estimated as nearly 22% of its total geographic area and about 26% of the total non-forest area of the district.
- In Golaghat district the weed infested in nearly 5.8% of its total geographical area, 9.8% of its total upland area, and about 8.2% of its non-forest area.
- In comparison to *Chromolaena* infestation in Golaghat district in the year 2013 (which was about 15782 ha), the present study recorded nearly 28% area increase in coverage in 2023 since 2013.
- Efficiency in seed production, seed dispersal by virtue of parachute mechanism, regular vegetative propagation by means of drooping stem, followed by rapid colony formation habit, and tremendous adaptation capacity in diverse land forms, might be the reasons of rapid infestation of the weed in the study area.
- Increase of the duration of summer season, gradual reduction of annual rainfall in Assam might be one of the causes of increasing infestation of the weed.

***Panicum repens* L.**

Common name: Torpedo grass; Vernacular names: Kodo dhan (Asm.; Beng.)

Panicum repens is one of the most troublesome

perennial facultative grassy weeds of field crops. Its prominent rhizome system, comprising of moniliform rhizomes, stolons and suckers, are deep rooted in the soil, which made the weed rather persistent against all sorts of management practices. The biology study revealed the following facts:

Number of panicles/ sq.m.: 224 ± 26

Number of spikelets/ panicle: 87.8 ± 4.5

Number of seeds/ sq.m. : 19,264 ± 2248

Rhizome length/ sq.m.: 3.07 ± 1.89 m.

Fresh weight of aerial portion: 81.73 ± 70.88 to 540 ± 64.81 g/m^2

Fresh weight of underground portion: 75.00 ± 39.22 to 1380 ± 56.27 g/m^2

Dry weight of aerial portion: 220 ± 59.61 g/m^2

Dry weight of underground portion: 680 ± 76.87 g/m^2

Management of *Panicum repens*: An experiment was laidout at Instruction-cum-Research Farm, AAU, Jorhat to manage the weed in non-cropped situation. *Panicum* dominant area was selected for this experiment. Foliar application of herbicides was done on 01.07.23; second application of herbicides was done on 01.09.23 (after regeneration of the weed). The herbicidal effect on the weed was studied by digging the underground rhizomes on 01.08.23, i.e. one month after first application of herbicide and on 11.10.23 and 26.12.23 *i.e.* 70 and 145 days after second application of herbicides, respectively.

· Cut the weed at ground level and allowing for regeneration before foliar application of herbicides could not give any special benefit in managing the weed, *Panicum repens*. The weed was regenerated from the underground perennial rhizome after two to three weeks of cut of the aerial portion or the damage caused by the first application of glyphosate.

· Repeated application of Glyphosate twice, at an interval of two months, as well as cut of aerial portion of the weed has delayed the emergence of culm and thus delayed the seed production at least for one month.

· Application of Glyphosate 71% premixed Ammonium sulphate and Glyphosate 41%+ Ammonium sulphate twice at an interval of two month had shown 91.94% and 91.04% control of *Panicum repens* in non-cropped situation, damaging nearly 90.7% and 88.9% underground rhizome of the weed, respectively.

WP 2.3. Identification of new herbicides and study of their effect on cutting and spray time for the management of *Lantana*

Centre: CSKHPKV, Palampur

Least regrowth of *Lantana* was recorded after April cutting and regrowth of *Lantana* was more after May cutting. Among time of spray, after 2 months of cutting had more regrowth of *Lantana* over spray after 1 month cutting. Application of glyphosate (1.5 kg/ha) had the least regrowth of *Lantana* bushes and more regrowth was recorded with treatment where no herbicide was applied. The effect of time of cutting and time of spray on number of shoots per plant were found to be non-significant. With herbicide application number of shoots per plant was found to be lower with glyphosate (1.5 kg/ha) which was statistically at par with glyphosate + surfactant (1.5 kg/ha + 1000 kg/ha). The lowest number of leaves per plant was found to be in April cutting of *Lantana* as compared to May and August cutting. The number of leaves per plant was not significantly affected by time of spray and herbicide application.

WP 2.4. Management of *Salvinia molesta* in rice fields

Network centres: KAU Thrissur, OUAT Bhubaneshwar, UAS Bengaluru, BCKV Kalyani

A pot culture study with the following treatments will be conducted in the first year. A uniform quantity of fresh *salvinia* in the mat stage will be put in the tanks with a surface area of 0.3 m^2 and grown to have uniform full coverage in the tank and the treatments will be imposed (spraying or broadcasting depending on the chemical/fertilizer). In the second year, the best treatments selected from the study will be tried in the standing rice crop of rice where *Salvinia* infestation is a problem.3

KAU, Thrissur

A. Tank study

The status of control in **Table 2.4.1.**

Table 2.4.1 Effect of treatments on fresh weight of *Salvinia* 40 days after treatment application (tank study)

Treatment	*Change in fresh weight of salvinia (kg)	Status of control
Glufosinate ammonium (0.30 kg/ha)	-3.0	Complete
Glufosinate ammonium (0.50 kg/ha)	-3.0	Complete
Carfentrazone ethyl (0.02 kg/ha)	-3.0	Complete
Carfentrazone ethyl (0.04 kg/ha)	-3.0	Complete
Cyhalofop butyl + penoxsulam (0.15 kg/ha)	-3.0	Complete
Florpyrauxifen-benzyl + cyhalofop butyl (0.15 kg/ha)	-3.0	Complete
2,4-D Amine (1 kg/ha)	-1.00	Slight
Butachlor + penoxsulam (0.82 kg/ha)	-3.0	Complete
Salicylic acid (5%)	-3.0	Complete
Acetic acid (5%)	-3.0	Complete
NaCl (5%)	+ 0.01	Nil
Copper sulphate (5%)	-3.0	Complete
Lime (1000 kg/ha)	-0.710	Slight
Gypsum (1000 kg/ha)	+ 0.312	Nil
Untreated check	+ 0.101	Nil

Effect of various treatments on *salvinia*

Effective control of *salvinia* was observed when sprayed with herbicides glufosinate ammonium, (florpyrauxifen benzyl + cyhalofop-butyl), (cyhalofop butyl + penoxsulam) and (butachlor + penoxsulam).

Among the various chemicals tried 90% control was observed in salicylic acid, copper sulphate, and acetic acid. However, a few new sprouts were observed by 40 days after spraying. Spraying of 2,4-D amine resulted in only 17% control whereas for lime 32% control was observed. In both cases, regrowth was observed by 20 days after treatment application (DAT). Sodium chloride spray was ineffective whereas gypsum enhanced the growth of *salvinia*.

The pre-mix herbicide (butachlor + penoxsulam) was found to be most effective in terms of rapid action as well as complete drying (98%) of salvinia. As drying started the next day of spraying and phytotoxicity score of 5 could be observed by three days after spraying (DAS). Also, by ten days, the entire salvinia mat decayed without any regrowth.

Another effective herbicide was (cyhalofop-butyl + penoxsulam) and unlike in the case of other herbicides, the weed mat sank completely in the surface layer within one hour of spraying. Hence a microscopic examination of the fronds was done. The upper surface of the floating fronds of this fern has rows of cylindrical papillae. Each papilla has paired hairs at its distal end that are joined together at their tips to form an inverted eggbeater shape. This peculiar structure traps air providing the buoyancy to float in water. Microscopic examination of fronds after herbicide application showed complete damage to the eggbeater shaped brizzles of the papillae due to this herbicide application resulting in the sinking of the weed mat. However, as the fern retained the green colour, the phytotoxicity score was 1 by two days of spraying and ultimately leading to a score of 4 by 20 DAT. In this treatment the complete control of *salvinia* 98% was registered at 40 DAT with a phytotoxicity score of 5 with no traces of regrowth.

In the case of pre-mix herbicide (florpyrauxifen benzyl + cyhalofop butyl), the action was slow and symptoms of phytotoxicity appeared only after one week as in the case of carfentrazone-ethyl. A phytotoxicity score of 5 with 98% efficiency was registered in (florpyrauxifen benzyl + cyhalofop butyl) at 40 DAT.

Spraying broad-spectrum contact herbicide glufosinate ammonium at the rate of 0.3 or 0.5 kg/ha was also very effective against *salvinia* and within 15 days of spraying, a phytotoxicity score of 5 and above 95% of control by 20 days was observed. As there was no difference between the two doses tried, it can be inferred that a lower dose of 0.3 kg/ha is sufficient for managing the weed. Glufosinate-ammonium can be recommended in paddy fields for preparatory cultivation.

Carfentrazone-ethyl at 0.02 and 0.04 kg/ha was slow in action, as the symptoms of phytotoxicity were observed only after one week of spraying. Carfentrazone ethyl also can be categorized as an effective herbicide for *salvinia* as complete drying occurred and no regrowth was registered. Also, a final phytotoxicity score of 4 was observed at 40 DAT. Hence, a lower dose of 0.02 kg/ha can be recommended for *salvinia* control. Contrary to the above, in the case of 2,4 - D amine only slight phytotoxicity of *salvinia* could be observed and regrowth was seen 10th day onwards, indicating partial control. Also, a reduction in fresh biomass of *salvinia* to the tune of 1.00 kg with only 17% control was observed. Due to the regrowth of the fern, the phytotoxicity score decreased to 1 by 15 DAT.

In the case of herbicides or other chemicals which caused phytotoxicity on the fronds, stereo microscopic examination revealed complete drying of hairy bristles, but it retained the egg beater shape and hence the fern even after herbicide application could retain its buoyancy and floated on the water surface.

In the case of the application of salicylic acid, acetic acid, and copper sulphate, quick control was observed within 24 hours of application, and the phytotoxicity score was 5 within two days of spraying. Also, till 30 days of spraying regrowth did not occur. However, by 40 DAT regrowth was registered, indicating the short-term activity of the chemicals. The use of lime resulted in slight control, maximum phytotoxicity score of 2 by 10 DAT, and showed a decline to the tune of 23% in fresh weight by 40 days after treatment (DAT) and regrowth was observed from the 2nd week after application. Gypsum application had no inhibitory effect on salvinia. On the contrary, it enhanced the growth as indicated by an increase in fresh weight by 10% at 40 DAT, compared to the initial weight. Spraying 5% solution of common salt had neither a toxicity effect on the fronds nor an effect on the growth of the fern. By 40 DAT, a constant fresh biomass weight (3 kg) was registered in this treatment.

A. Experiment on the management of Salvinia infestation in transplanted rice (Field study)

Treatments:

T1 - Penoxsulam + butachlor, 820 g/ha

T2 - Cyhalofop butyl + penoxsulam,150 g/ha

T3 - Pretilachlor + pyrazosulfuron ethyl, 600 g/ha

T4 - Florpyrauxifen benzyl, 31.5 g/ha

T5 - Hand weeding at 20 and 40 DAT

T6 - Unweeded control

(Note: All herbicides were sprayed along with sticker @ 2 ml/L of spray fluid)

The dry weight of *salvinia* was recorded two months after the treatment application. At both the locations of study, a considerable reduction in *salvinia* population could be observed and all the herbicidal sprays were effective and comparable with respect to weed dry matter. The reduction in dry weight over unsprayed check was to the tune of 85%.

Weed control efficiency also followed a similar trend and almost comparable values ranging from 83-87% were registered at location 1, whereas at location 2, a slightly lower efficiency of 76-79% was registered, indicating the effectiveness of all herbicides tried in *salvinia* management.

Growth parameters of rice were recorded at 30, 60, and 120 days after herbicide application. The data revealed that crop growth was severely affected by competition from *salvinia*. At 30 days of herbicide application, the reduction in plant height in unweeded check was about 30%. By the time of harvest on average the plant height of rice was higher as well as comparable in all herbicide-applied plots due to no competition from the weed and all herbicidal treatments were at par statistically at all stages of observation.

Tillering in rice was also severely affected and only 10.70 tillers per hill were observed in untreated check (Location 1 & 2) whereas the average tiller number in herbicide-applied plots was 25 numbers/hill.

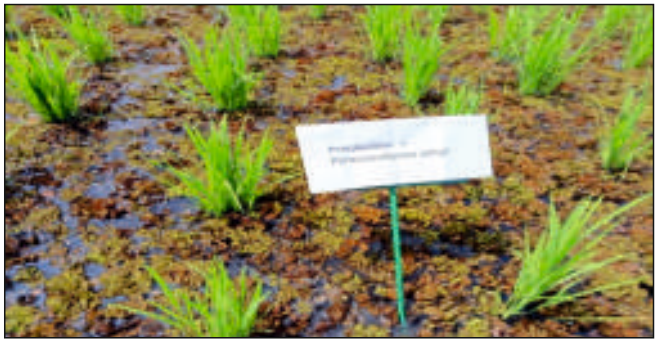
The grain and straw yield varied between untreated check and herbicidal treatments. The trend was almost the same in two locations with all herbicide treatments registering higher as well as statistically comparable values of grain and straw yield. In the pooled data, the grain yield in herbicide-applied plots ranged from 4.8 t/ha to 5.0 t/ha which was at par, the average value being 4.9 t/ha. In untreated check, the yield was only 2.3 t/ha, with 55% grain yield reduction due to competition from *salvinia*.

Effect of penoxsulam + butachlor
(Two weeks after spraying)

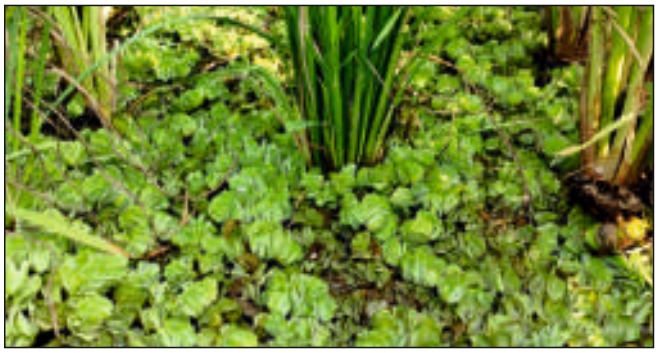
Effect of penoxsulam + butachlor
(Five weeks after spraying)

Effect of florpyrauxifen-benzyl
(Two weeks after spraying)

Effect of florpyrauxifen-benzyl
(Five weeks after spraying)



Effect of pretilachlor + pyrazosulfuron
(Two weeks after spraying)



Thick *salvinia* mat in the unweeded plot

Growth of *Salvinia* in hand-weeded plot
(Five weeks later)

OUAT, Bhubaneshwar

The application of 2,4-D Na salt 0.5 kg/ha and metsulfuron methyl+chloromuron ethyl 4 g/ha were found to be the best screened-out chemical in managing *Salvinia molesta* , the aquatic fern in the low land /deep water rice field.

UAS, Bengaluru

Pot culture study

The treatments carfentrazone – ethyl @ 0.02 kg /ha, metsulfuron + chlorimuron 4 g/ha, cyhalofop butyl + penoxsulam 0.15 kg /ha and penoxsulam + butachlor 0.82 kg /ha were effective in controlling *Salvinia* during pot study and were selected for the field experiments for further study in paddy field. However, till now Bangalore center has not noticed any standing rice crop where *Salvinia* infestation is a problem.

WP 2.5. Control of aquatic weed *Vallisneria* in wetland rice

Centre: KAU Thrissur

Among the herbicides tried, 2,4-D sodium salt, florpyrauxifen-benzyl as well a pre-mix combination of florpyrauxifen-benzyl+ cyhalofop butyl were effective in controlling vallisneria with 98-100% WCE recorded at 20 days after spraying. The weed control efficiency was slightly reduced by 50 days after spraying and at the harvest stage of rice due to the emergence of new seedlings of vallisneria. Compared to the other two herbicides, 2,4-D sodium salt registered the highest WCE of 96% at 50 days and 90% at harvest. The reduction in yield due to competition of this weed is yet to be confirmed **(Table 2.5.1).**

Table 2.5.1 Effect of treatments on weed control efficiency at different stages (%)

Treatments	20 DAS	50 DAS	Harvest
Penoxsulam + butachlor 0.82 kg/ha	21.73	5.59	5.45
Penoxsulam + pendimethalin 625 g/ha	13.46	24.26	23.16
2,4-D sodium salt, 1 kg/ha,	100.00	96.08	90.19
Carfentrazone-ethyl 0.02 kg/ha	10.47	29.37	14.17
Cyhalofop butyl + penoxsulam 0.15 kg/ha	3.72	36.15	27.25
Florpyrauxifen-benzyl + cyhalofop butyl 0.15 kg/ha	98.75	88.35	79.84
Bispyribac sodium 25 g/ha	1.55	24.61	7.08
Florpyrauxifen-benzyl 31.5 g/ha	98.56	89.06	77.11
HW 20 & 40 DAT	100.00	93.82	80.38
UWC	-	-	-

DAS – Days after spraying

Florpyrauxifen-benzyl + cyhalofop butyl 0.15 kg/ha

Untreated check

WP 2.6 Management of aquatic weeds in farm ponds by pond liming

(The common aquatic weeds in fresh water ponds include *Hydrilla, Najas, Utricularia* and algae)

Centre: KAU Thrissur

Treatments:

T_1 - Ordinary burnt lime (CaO)

T_2 - Super active burnt lime (CaO)

T_3 - Dolomite ($CaCO_3$ & $MgCO_3$)

T4-Control

Note: The quantity will be fixed based on the pH of the water body. The rate and frequency of application will be standardized based on a study under controlled conditions in artificial cement tanks and preliminary studies have already been initiated.

Management of *Cabomba* through calcium oxide application

Quick lime (calcium oxide) was applied at varied rates to *cabomba* grown in cement tanks with a water volume of 40 L. Observations on chlorophyll content were recorded over a period starting from 2 hrs after the application of quick lime.

The visual phytotoxicity rating followed a similar trend as that of chlorophyll content and no phytotoxicity could be observed till 1 DAA, except at a higher dose of 10 g/L where slight control was visible. With time as well as the dose of CaO, phytotoxicity increased. Complete control (score 5), was registered from 21 DAA, at higher doses of 6, 8 & 10 g/L. By 30 DAA all the doses from 2-10 g/L, also registered complete control. However, this effect of lower doses can be expected under artificial conditions as in the case of tanks, where there is no movement of water or addition of water through rainfall or natural sources.

The same trend as that of phytotoxicity score was registered for the percentage control also and at 14 DAA the percentage control was only 40%, the lowest dose of 2 g/L whereas it was 80% for 6 & 8 g/L of CaO. By 21 DAA, the percentage control increased to 80% at 2 & 4 g whereas 100% control registered for 6,8 & 10 g/L. By 30 DAA, all the doses of CaO resulted in total control. Also, no regrowth of cabomba was there.

Management of *Limnophila* through calcium oxide application

The same methodology as described for *Cabomba* was followed. The same trend as observed in the case of Cabomba was registered here also.

In the tank study, visual phytotoxicity and chlorophyll degradation were observed from 7 DAA, and at higher doses, the response was quick. By 30 DAA, the phytotoxicity score was 5 in all doses from 2 to 10 g CaO and no regrowth could be seen.

Management of *hydrilla* through calcium oxide application

The same methodology as described for *cabomba* was followed. The trend was similar with quick control by 7 DAA at higher doses of 8 g and 10 g CaO where, the phytotoxicity score was 4, whereas, at lower doses, it took two weeks to attain a score of 4. By 3 weeks, all the doses from 4 to 10 g CaO registered a score of 5 with the complete control, and no regrowth could be observed indicating good WCE. pH and EC of water increased with CaO application and increase was more at higher doses of 8 and 10 g CaO.

Management of *Limnophila* in the irrigation channel

The field testing of the technology was done at the Kole lands of Thrissur, Pullazhy Kole where the infestation of *limnophila* was noticed in a lined irrigation channel with an almost stagnant water column. The depth of water in the channel (0.30 m), and width (1.5 m) of the channel were measured, and based on the length of the treatment area (5m), the volume of water was calculated (2250 L). The required quantity of calcium oxide to be applied was arrived at and applied (4.5 kg, 9 kg, and 13.5 kg, respectively for 2 g, 4 g, and 6 g Calcium oxide). Observations on chlorophyll content and phytotoxicity scoring were recorded, based on which the percentage control was worked out.

As in the case of the tank study, the chlorophyll content decreased from one day after application to three weeks after, and with the increase in the dose of calcium oxide, chlorophyll degradation was faster. The same was the trend with phytotoxicity symptoms.

The percentage control followed a similar trend and was proportional to the visual phytotoxicity score and chlorophyll content. At 21 DAA, the percentage control of limnophila, based on phytotoxicity score was 20% at the lowest dose of 2 g CaO, 60% at 4 g CaO, and 100% at 6 g CaO, compared to untreated check. Corresponding percentages based on chlorophyll content were 12%, 57% and 100% respectively. Hence it could be inferred that a minimum dose of 6 g CaO per L of water in the channel is required to get 100% control in three weeks.

The change in pH and EC of the water in the channel was also monitored from 2 hr after application to 21 days after application. The initial pH was 6.51, which increased to 8.37 at the lowest

dose of 2 g CaO to 8.82 at 6 g CaO. EC of water increased with lime application and the highest value of 0.35 units was registered at 2 HAA in 6 g CaO. Even at 21 DAA, the increased EC was observed in all treatments over untreated check and the higher doses of 4 and 6 g CaO were at par with the average EC of 0.30, whereas in untreated check it was 0.21.

Location: Ollukkara

Before liming

After liming

Location: Mudikkode

Before liming

After liming

WP 2.7. Biological control of *Salvinia molesta*

Network centres: PDKV Akola, CCHAU Hisar, IGKV Raipur

Technical programme:

- Select at least two perennial ponds/lacks/ stagnated or slow flowing aquatic body infested with *Salvinia molesta* for study .
- Take *Salvinia molesta* dry weight by five random samples of one square meter each from the site with the help of quadrate.
- Release 1000 to 2000 adult beetles in one pond releasing 200 to 250 adults at different spots of the water body.
- Efforts should be made to release the bioagent in the deepest water point of the pond with the help of fishermen.
- Count adult weevils from the 5 samples from 0.25 m^2 quadrate taken on quarterly basis.
- Count the damaged growing buds from the same samples.
- After counting the adult and damaged buds, the biomass should be dried for taking dry weight.
- Note dieback type or dryness symptoms on Salvinia on 0-100%
- Observe the clear water appearance on the basis of percent considering whole aquatic body for example 0 to 100% scale

- After complete control and clearance of water, observe further re-emergence of *Salvinia molesta* in the same pond and follow the procedure.

The water bodies which are likely to dry during summer season should not be selected because in such sites *Salvina molesta* plants will anchor on the soil which will kill the bioagent inside. Those sites should also not be selected which are likely to flooded during rainy season as all the such Salvinia *molesta* along with bioagent will wash away with the flood. Therefore, more visible impact of bioagent can be demonstrated in ponds, lakes and reservoirs having water throughout the year.

Note: Those centers which are not having established sites with the bioagent, they may indent for bioagent in advance to DWR to receive the culture.

It is advised to take the photograph of the aquatic body keeping any permanent mark in the picture before release of the bioagent and in due courses the picture should be taken from that angle only to see the impact of bioagent on long term basis.

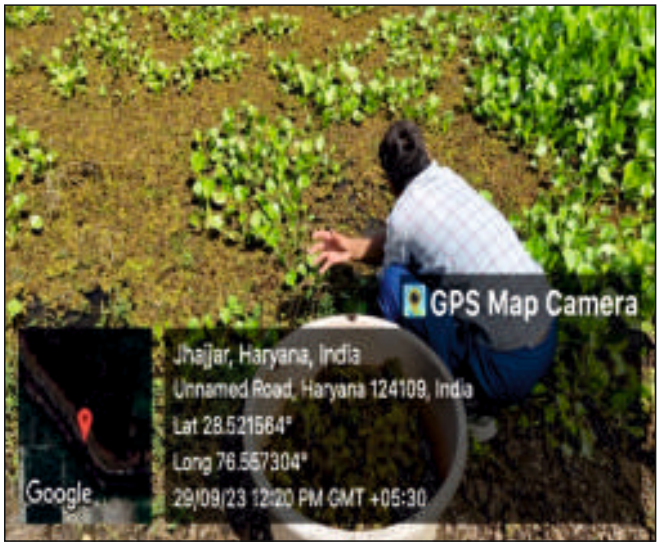
Table

Year/ Month :

Sample No.	Adults (No/m ^{2})	Damaged growing points (no./m ^{2})	Dry weight (g/m ^{2})	Damage (0-5 scale)	Clear water surface (10 to 100%)
1 to 5 Av ±SD					

CCHAU, Hisar

- *Salvinia* is collected from the Bhindawas lake
- Collected weed grown in the pits at the Research Farm of the Department of Agronomy
- The insect reared by an Entomologist and data on the insect survival will be reported in the climatic conditions of Hisar.
- After rearing, the insect will be dropped in the Bhindawas lake for the control of the weed



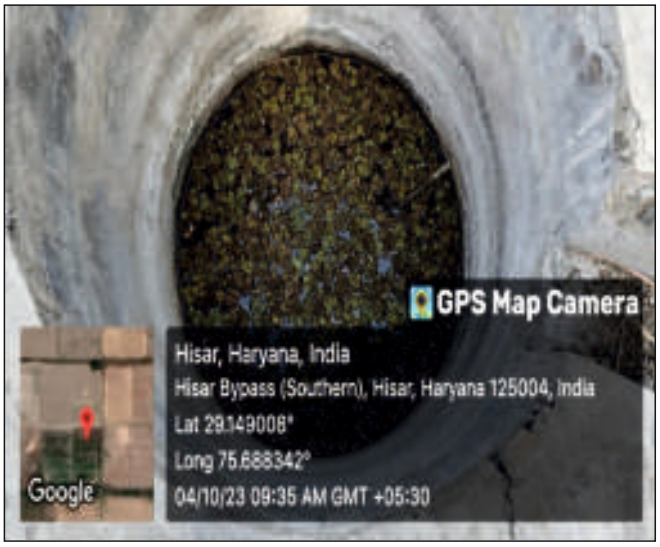


Plate: Collection of Salvinia from Bhindawas Lake and at Hisar (in pits)

IGKVV, Raipur

Infestation of Salvinia in Khapri Pond, Distric Balod, visted during September 2023

WP 2.8. Biological control of water hyacinth by *Neochetina* spp.

Network centres: All centers except UASB / KAU / AAU, Jorhat and PAJANCOA & RI, Puducherry

Technical programme and observations

- Select at least two to three perennial ponds/lacks aquatic body infested with water hyacinth in your university jurisdiction. It is not necessary that pond should be located in your city.
- Take Water hyacinth density by three random samples of one square meter each from the site and dry weight with the roots
- Release 500 to 1000 adult beetles in one pond distributing 100 to 200 at different sites in the water body
- Observe population build-up of the bioagent from the same pond by taking 25 plants at six monthly basis
- Count carefully the grubs and adults from each plant and present the data on average basis*
- Note dieback symptoms on water hyacinth plants on 0-4 scale, (0-No attack; 1- negligible, 2-25%; 3-50%; 4-75%; 5-complete dry up of whole plant).
- Observe the clear water appearance on the basis of percent taking into account whole aquatic body for example. 25 to 100%.
- After clearance of water observe further re-emergence of the water hyacinth in the same pond and follow the procedure.

*The water bodies which are likely to dry during summer season should not be selected because in such sites water hyacinth plants will anchor on the soil which will kill the bioagent inside. Those sites should also not be selected which are likely to inundated during rainy season as all the such water hyacinth along with bioagent will wash away with the flood. Therefore more visible impact of bioagent can be demonstrated in ponds, lakes and reservoirs having water throughout the year. In cold region, dieback type of symptoms may appear during winter season, therefore, it should be avoided during winter season.

It is advised to take the photograph of the aquatic body keeping any permanent mark in the picture before release of the bioagent and in due courses the picture should be taken from that angle only to see the impact of bioagent on long term basis.

Table

Year/Month :

Plant No.	Adult s	Feeding scarce on Leave	Dry weight (g/m ^{2})	Damage (0-5 scale)	Clear water surface (10 to 100%)
1 to 25 Av ±SD					

AAU, Anand

At Sadanapura during 2023, some feeding scars were observed on the water hyacinth leaves/plant. Some dieback symptoms were recorded on the water hyacinth plants (0 scale) by the weevil but water hyacinth was not controlled by the weevil.

TNAU, Coimbatore

Neochetina weevils collected from various sources were released on 31.10.2022 & 18.11.2022 in the newly emerged water hyacinth patches at Krishnampathy tank near Wetland farm of TNAU. Number of weevils survived at the time of release was around 650. Observation on the population buildup of beetles, dieback symptoms on water hyacinth plants and clear water appearance were recorded. There was a spread and multiplication of *Neochetina* beetles which had a significant impact on water hyacinth. The damage rate was found to about 50% (scale -3). On average, the dry weight of water hyacinth was reduced to 533 g/m^2 which was about 737 g/m^2 at the time of release of beetles.

Subsequently, during June 2023, the water hyacinth in the tank was cleaned under "Smart city project" for beautification of corporation lakes by the Coimbatore corporation.

PAU, Ludhiana

Water ponds of village Dehlon (Ludhiana) and Narangwal (Ludhiana) were selected for studies of control of water hyacinth by *Neochetina* spp **(Figure 2.8.1)**. Ten water hyacinth plants were tagged in the pond for record of periodic data on insect population and damage. As *water hyacinth* had large leaf area and beetle build-up was not high enough so the beetle could do only fair damage of leaf tissues.

Figure 2.8.1 Biological control of water hyacinth by *Neochetina spp.* at Dehlon

RVSKVV, Gwalior

In the second phase of the experimentation, one perennial pond infested with water hyacinth was selected in the village Hanumangarh, District Gwalior to release the weevils in 2019. After the survey of water body, it was found that more than 90% visual area was covered by water hyacinth. Before release of the weevils, five random samples were taken to measure the density of water hyacinth by the quadrate (1x1) m. places. Near about 500 weevils were spread evenly on the entire pond. These weevils were collected from the pond situated near Pilua Dam, Morena and stored in the earthen pots at the experimental site, College of Agriculture, RVSKVV Gwalior campus and released during the month of September, 2019.

The observations on population buildup of the bio-agent from the same pond were taken by taking 15 plants at randomly at six-month interval. Plucked 15 leaves, one from each plant and count the feeding scars on each leaf and averaged it. Then counted weevils carefully in each of the removed plant on the collar point and amidst the leaves around and averaged the weevil population. The dieback symptoms on water hyacinth plants were measured on 0-4 scale, (0 – no dieback, 1 – negligible, 2 – 25%, 3 – 50%, 4 – 75%, 5 – complete dry up of whole plant). As per local communities the water level of the pond was around 10 feet of the same body.

The population of bio-agents was increased and got average 9.35 adult/plant in the month of September, 2023 after 4 years. The feeding scars were also increased and got 32.3 /leaf and were found 0- 10 on average. The population of bio-agents increasing as compared to the last six months. Dieback symptoms on leaves had also been increased.

View of new selected pond near Gwalior

Count of weevils/plant

This study of biological control of water hyacinth by *Neochetina bruchi* weevils, this year study was based on the effect of earlier released and developed population of *Neochetina bruchi* weevils on the density of water hyacinth (*Eichhornia crassipes)* in the affected water body. The study was evaluated by taking an observation of the population of weevils and the density of *Eichhornia crassipes* periodically. The observation showed that there was no significant build-up in the population. The observations recorded based on the weevil's populations on the water hyacinth plant. Average of about 4.4-6.2 adults per plant were observed on the plants with damage on plant foliage of 1 on 0-5 scale with efficiency of 10% to clear the water surface.

SKUAST, Jammu

In water hyacinth infested pond only average 12-15 feeding scars/leaf were observed and only few die back symptoms were also observed. *Neochetina* spp caused 4-8% die back symptoms in water hyacinth infested pond after four years release of *Neochetina* spp. at Tanda village.

WP 2.9. Efficacy of *Alternanthera philoxeroides* aqueous extracts on growth and development of *Eichhornia crassipes*: A Green Approach

Efficacy of *Alternanthera philoxeroides* aqueous extracts on growth and development of *Eichhornia crassipes*: A Green Approach

Centre: UAS Bengaluru

Treatments:

T_1 to T_5 (root extract with 5, 10, 20, 40 and 80g L^{-1})

T_6 to T_{10} (stem extract with 5, 10, 20, 40 and 80g L^{-1})

T_{11} to t_{15} (leaves extract with 5, 10, 20, 40 and 80g L^{-1})

T_{16} to T_{20} (leaves extract with 5, 10, 20, 40 and 80g L^{-1})

T_{21}-Control

Water hyacinth sprayed with different plant part extract of *Alternanthera* extract on small and big plants is as follows. Water hyacinth of small size plants showed discoloration and injury were pronounced and persistent at 5 days after spray. At 15 days after spray water hyacinth plants were severely injured and showed significant decrease in growth and fresh weight and was almost destroyed with few plants surviving at 15 days after spray (**Table 2.8.1).** Big size plants showed destruction rate at slower phase. The leaves in contact with extract decayed. Slow recovery was noted at 30 days after spray.

Table 2.8.1 Influence of different plant parts extracts of *Alternanthera philoxeroides* on Big plants size of water hyacinth at 15 DAS

Treatments	Plant ht (cm)	Root length (cm)	No of leaves	No of leaves affected	Fresh weight (g/plant)
T_1- Control	55.6	23.7	9	0	169.3
T_2- Stem extract 80 g/plant + X compound	37.8	17.8	8	6	159.3
T_3- Root Extract 80 g/plant + X compound	12.6	10.1	9	6	92.7
T_4- Leaf Extract 80 g/plant + X compound	12.3	12.3	9	7	84.7
T_5- Whole plant extract 80 g/plant + X compound	11.0	8.0	7	5	63.3
T_6- Whole plant extract 100 g/plant + X compound	12.8	9.4	8	6	72.7
T_7- Whole plant extract 120 g/plant + X compound	9.7	7.2	7	5	57.3
SEM+	1.64	1.26	1.11	0.90	22.36
LSD (P=0.05)	5.04	3.87	NS	2.76	68.90

Influence of different plant parts extracts of *Alternanthera philoxeroides* on water hyacinth at 15 Days after spray (Big size)

WP 2.10. Identification of weeds of national importance (WoNI)

The objective of this study is to identify the weeds of national importance. For the purpose, Questionnaire was prepared and information was collected from primary and secondary sources from each district of the state where centre is located. Questionnaire contains the information on different parameters such as invasiveness' and 'impacts' criteria; potential for spread' criterion; socioeconomic and environmental values; economic data for agricultural and forestry weeds (primary industries); environmental values; biodiversity indicators; threatened species data; number of threatened conservation areas; conservation indicators; monoculture potential; social values etc. Based on these criteria, centres identified different weeds of national importance in their state which are summarized in the following table:

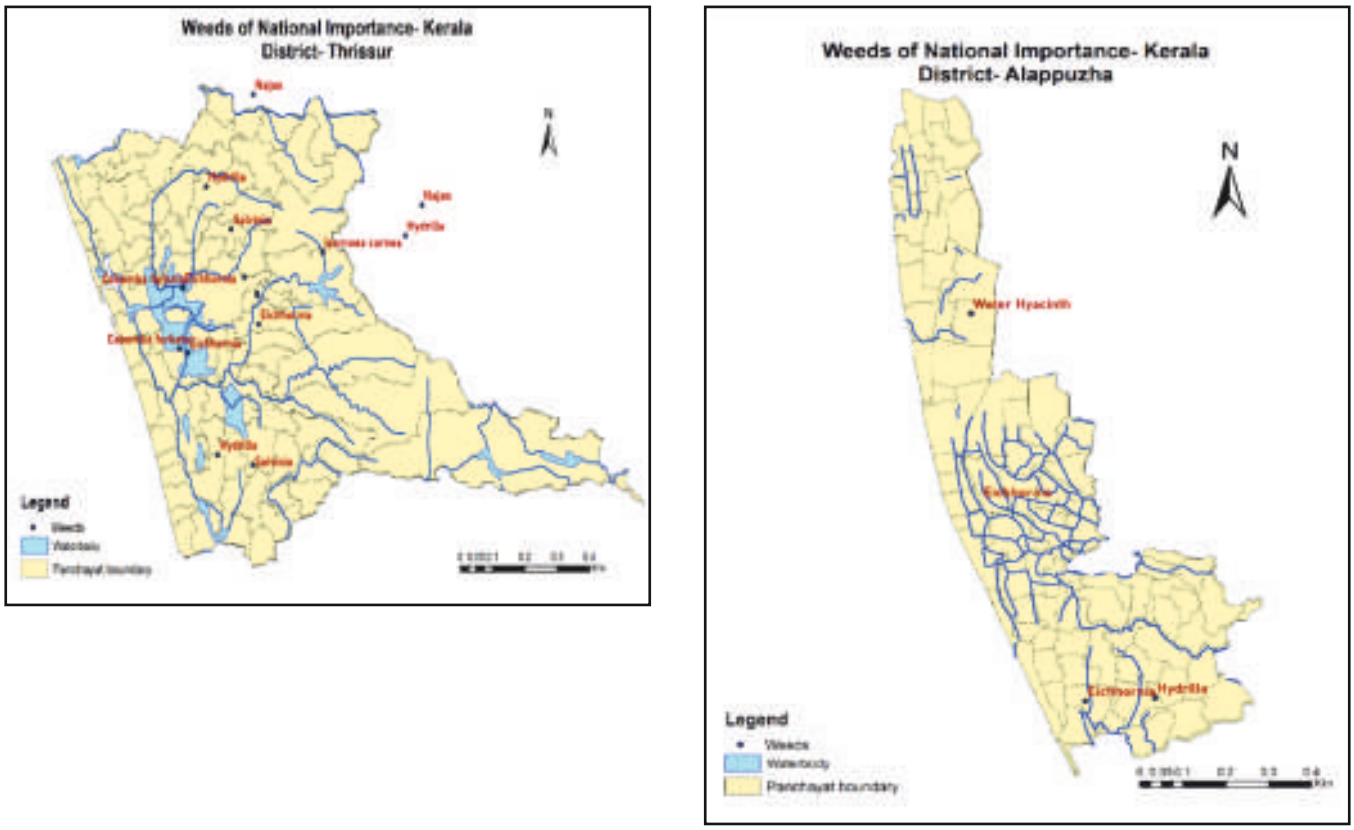
Centre	Name of Weeds of National Importance				
PJTSAU, Hyderabad	*Parthenium hysterophorus*	*Cyperus rotundus*	*Echinochloa crus-galli*	*Celosia argentea*	*Eichhornia crassipes*
KAU, Thrissur	*Eichhornia crassipes*	*Mikania micrantha*	*Salvinia molesta*	*Echinochloa* sp.	*Alternanthera bettzickiana*
CSKHPKV, Palampur	*Lantana camara*	*Parthenium hysterophorus*	*Ageratum conyzoides*	*Bidens pilosa*	*Avena fatua*
	Sorghum halepense	*Phalaris minor*	*Oxalis latifolia*	*Synedrella vialis*	*Alternanthera philoxeroides*
CCSHAU, Hisar (Karnal, Kurukshetra)	*Phalaris minor*	*Trianthema portulacastrum*	*Digera arvensis*	*Dactyloctenium aegyptium*	*Echinochloa colon*
	Cyperus rotundus	*Orobanche*	*Chenopodium* spp.	*Avena ludoviciana*	*Rumex* spp.
UAS, Bengaluru	*Parthenium hysterophorus*	*Chromolaena odorata*	*Eichhornia crassipes*	-	-
AAU, Anand (Anand and Kheda district of Gujarat)	*Parthenium hysterophorus*	*Echinochloa crus-galli*	*Phalaris minor*	*Trianthema monogyna*	*Commelina benghalensis*
AAU, Jorhat	*Ludwigia peruviana*	*Mikania micrantha*	*Chromolaena odorata*	*Mimosa diplotricha*	*Panicum repens*
TNAU, Coimbatore	*Cyperus rotundus*	*Parthenium hysterophorus*	*Cynodon dactylon*	*Prosopis juliflora*	
PAU, Ludhiana	*Phalaris minor*	*Medicago denticulata*	*Echinochloa colona*	*Rumex dentatus*	*Chenopodium album*
	Cyperus rotundus	*Leptochloa chinensis*	*Avena ludoviciana*		
OUAT, Bhubaneswar	not available				
RVSKVV, Gwalior (Gwalior, Morena and Datia district)	*Phalaris minor*	*Parthenium hysterophorus*	*Cyperus rotundus*	*Saccharum spontaneum*	
MPUAST, Udaipur (Udaipur, Rajsamand, Dungarpur, Banswara, Chittorgarh, Pratapgarh and Bhilwara)	*Echinochloa colona*	*Commelina benghalensis*	*Trianthema portulacastrum*	*Asphodelus tenuifolius*	*Chenopodium album*
	Cyprus rotundus	*Parthenium hysterophorus*	*Lantana camara*		
SKUAST, Jammu	*Phalaris minor*	*Echinochloa crus-galli*	*Cirsium arvense*	*Medicago* spp.	*Chenopodium album*
GBPUA&T, Pantnagar (Nainital, Uttarakhand)	*Alternanthera paronychioides*	*Parthenium hysterophorus*	*Ageratum conyzoides*	*Stellaria media*	*Phalaris minor*
	Rumex spinosus	*Coronopus didymus*	*Chenopodium album*		

Information on aquatic weed infestation

TNAU, Coimbatore

Centre conducted the aquatic weed survey in the districts of Tamil Nadu *viz*. Ariyalur, Dharmapuri, Krishnagiri, Perambalur, Pudukottai, Thanjavur, Thirupattur, Thiruvarur, Trichy and Vellore during 2023. From the surveyed data, the common aquatic weeds that present in all the surveyed districts were *Prosopis juliflora* (24.5%), *Ipomoea carnea* (15.1%), *Cyperus distans* (13.2%) and *Eichhornia crassipes* (11.3%). Details are as follows:

Place, district, State	Name of the water body	Total area of water body (ha)	Weeds present in the aquatic body with infestation	
			Name of weed	Waterbody area infested with weed (%)
Ariyalur, Coimbatore	Periya yeri	4.86	*Ipomoea carnea*	50
	Karungulam yeri	0.78	*Nelumbo nucifera*	60
Kariamangalam, Dharmapuri, Coimbatore	Vannar lake	8.5	*Eichhornia crassipes*	30
Krishnagiri, Coimbatore	Krishnagiri periya lake	7.56	*Ipomoea carnea*	20
			Cyperus distans	20
	Manikanoor lake	15.71	*Ipomoea carnea*	10
			Cyperus distans	10
	Paiyur periya lake	78	Pistia stratiotes	20
			Eichhornea crassipes	30
Perambalur, Coimbatore	Arumbur sitheri	19.8	*Ipomoea carnea*	30
	Periyammapalayam lake	0.65	*Prosopis juliflora*	20
	Arumbavur periyeri	42	*Prosopis juliflora*	20
	Periyammapalayam sitheri	12.83	*Prosopis juliflora*	30
	Thaluthalai lake	6	*Prosopis juliflora*	30
			Ipomoea carnea	20
Pudukottai, Coimbatore	Thirumakeni kanmai	1.75	*Eichhornia crassipes*	90
	Sangana kanmai	1.74	*Prosopis juliflora*	30
	Neerpalani lake	69.6	*Prosopis juliflora*	50
	JJ nagar kanamai	12.75	*Ipomoea aquatica*	10
Thanjavur, Coimbatore	Samuthiram yeri	48.56	*Eichhornia crassipes*	10
	Ponan yeri	65.56	*Prosopis juliflora*	30
	Kallaperambur yeri	335.9	*Ipomoea aquatica*	10
			Prosopis juliflora	30
	Chithiraikudi yeri	1.2	*Nelumbo nucifera*	20
Pallipattu, Tirupattur, Coimbatore	Adiyur lake	1.5	*Prosopis juliflora*	30
Tirupattur, Coimbatore	Adiyur pond	0.49	*Cyperus distans*	40
	Adiyur pond 2	0.73	*Prosopis juliflora*	5
Adiyur, Tirupattur, Coimbatore	Adiyur pond 3	0.49	*Cyperus distans*	20
Mannarkudi, Tiruvarur, Coimbatore	Thamaraikulam	3.06	*Eichhornia crassipes*	30
			Cyperus distans	15
Tiruvarur, Coimbatore	Vadavoor lake	120	*Eichhornia crassipes*	30
	Rukmani kulam	1.5	*Cyperus distans*	30
Kallikudi, Tiruchirappalli	Kallikudi lake	35.7	*Ipomoea carnea*	40
			Prosopis juliflora	10
Vannankovil, Tiruchirappalli	Poongudi lake	33.18	*Ipomoea carnea*	60
			Prosopis juliflora	10
Nedumalai, Tiruchirappalli	Nedumalai lake	63.4	*Ipomoea carnea*	30
			Prosopis juliflora	30
Navalurkottapattu, Tiruchirappalli	Kunimarathan kovil kulam	20.54	*Prosopis juliflora*	30
Vellore	Ammundi lake 2	7.7	*Cyperus distans*	40



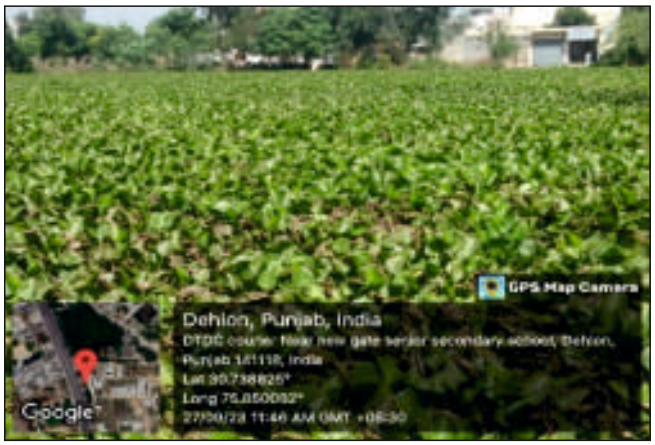
Water bodies with water hyacinth infestation

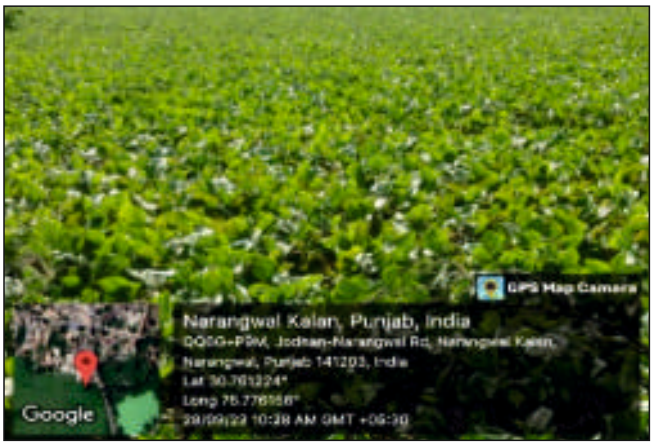
KAU, Thrissur

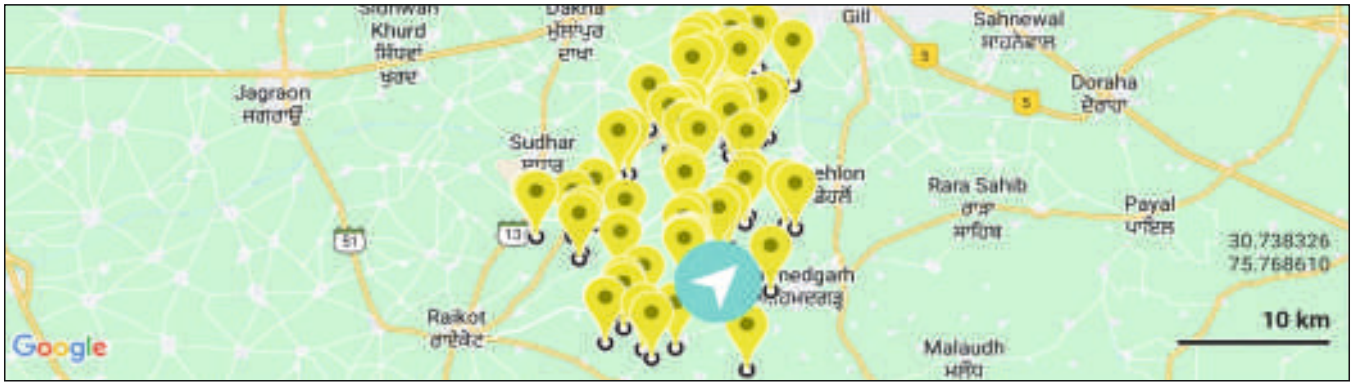
Based on surveys conducted in Thrissur and Alappuzha districts, aquatic bodies with severe infestation/ occurrence of alien weeds of national significance were mapped.

PAU, Ludhiana

Attempt was made to map the spatio-temporal dynamics of water hyacinth in Ludhiana district of Punjab based on accuracy of first developed spectral profile. A total of 1050 locations were obtained in first attempt and accuracy after ground truthing was less than 15%. The methodology was further improved and total of 306 locations were obtained in second attempt with 36.67% accuracy. To further validate methodology and improve accuracy, one block (Pakhowal) was selected. A total of 63 locations were detected by GIS technique and only 20% accuracy was obtained after ground truthing.





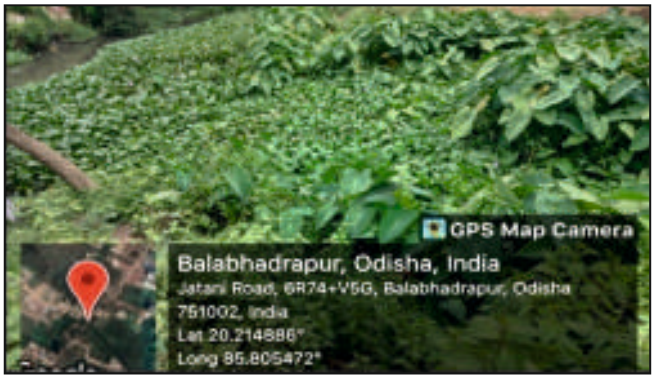


Map of locations showing the presence of water hyacinth obtained using hyper spectral data in Pakhowal block Distt. Ludhiana

OUAT, Bhubaneswar

Centre surveyed many aquatic bodies for observing the weed infestation level in different places. Details are as follows:

Place, district, State	Name of the water body	Total area of water body (ha)	Weeds present in the aquatic body with infestation	
			Name of weed	Waterbody area infested with weed (%)
Kantilo, Khorda, Odisha	Kantilo	-	*Pennisetum glaucum*	-
Balabhadrapur, Khorda, Odisha	Balabhadrapur Canal	-	*Eichhornia crassipes*	60
			Colocasia esculenta	40
Damanbhumi, Khorda, Odisha	-	0.45	*Azolla microphylla*	-
Ekamra Road, Bhubaneswar, Khorda, Odisha	-	0.125	*Pistia stratiotes*	-



PDKV, Akola

Centre surveyed water bodies of Akola, Yavatmal, Chandrapur, Gadchiroli, Buldhana, Washim and Bhandara districts for occurrence of aquatic weeds especially for *Eichhornia crassipes* (*Water hyacinth*), and *Salvinia molesta* (*Kariba* weed). However, water bodies located at Akola, Washim and Buldhana were infested with *Ipomoea sp*. in patches along the edges of ponds and at Yavatmal with lotus. *Cyrtobagous salviniae* successfully controlled the *Salvinia molesta* in lakes of Gadchiroli (Heti, Lanjeda and Indra nagarlake) and Chandrapur districts (Junona and Ghodpeth lake) of Maharashtra.

WP-3 Fate of herbicide residue in different agro-ecosystems

WP 3.1 Assessment of herbicide residues under program

WP-1.1 Weed management in major crops and cropping systems and station trials specific to the state

Network centres: Ludhiana, Palampur, Hyderabad, Coimbatore, Anand*, Hisar*, Bengaluru*, Kalyani*, Thrissur*

Pendimethalin from soil and mustard samples were quantified using HPLC at PAU, Ludhiana in an

experiment of effect of tillage and paddy residue management herbicide on weed management and productivity of mustard in rice mustard system. The LOD and LOQ of pendimethalin and pyroxasulfone in soil were 0.003 and 0.01 µg/g, respectively while from mustard it was 0.026 and 0.05 µg/g, respectively. The initial residues of pendimethalin ranged from 0.401 to 0.756 µg/g and 0.309 to 0.703 µg/g in conventional tillage (CT) and zero-tillage happy seeder (ZT-HS) treatments, respectively while pyroxasulfone residues ranged from 0.038 to 0.070 and 0.034 to 0.065 at studied application rates (Figure 3.1.1 and 3.1.2). The half-life for pyroxasulfone in CT and ZT-HS treatments varied from 11.38 to 13.19 and 8.88 to 13.19 days, respectively. The half-life for pendimethalin in CT and ZT-HS was from 20.21 to 28.51 and 17.43 to 23.73 days. The residues of pyroxasulfone and pendimethalin in soil (<0.01 µg/g) and mustard (<0.05 µg/g) at harvest were below detectable limit **(Table 3.1.1).**

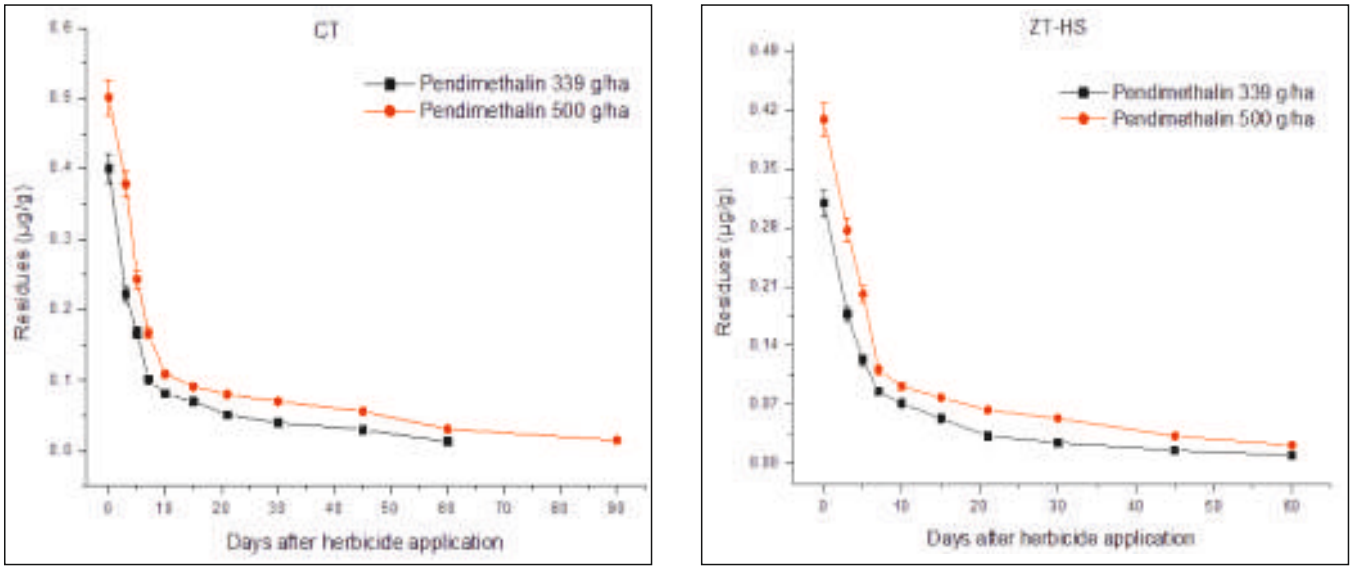


Figure 3.1.1 Residues of pendimethalin at studied application rates in CT and ZT-HS treatments

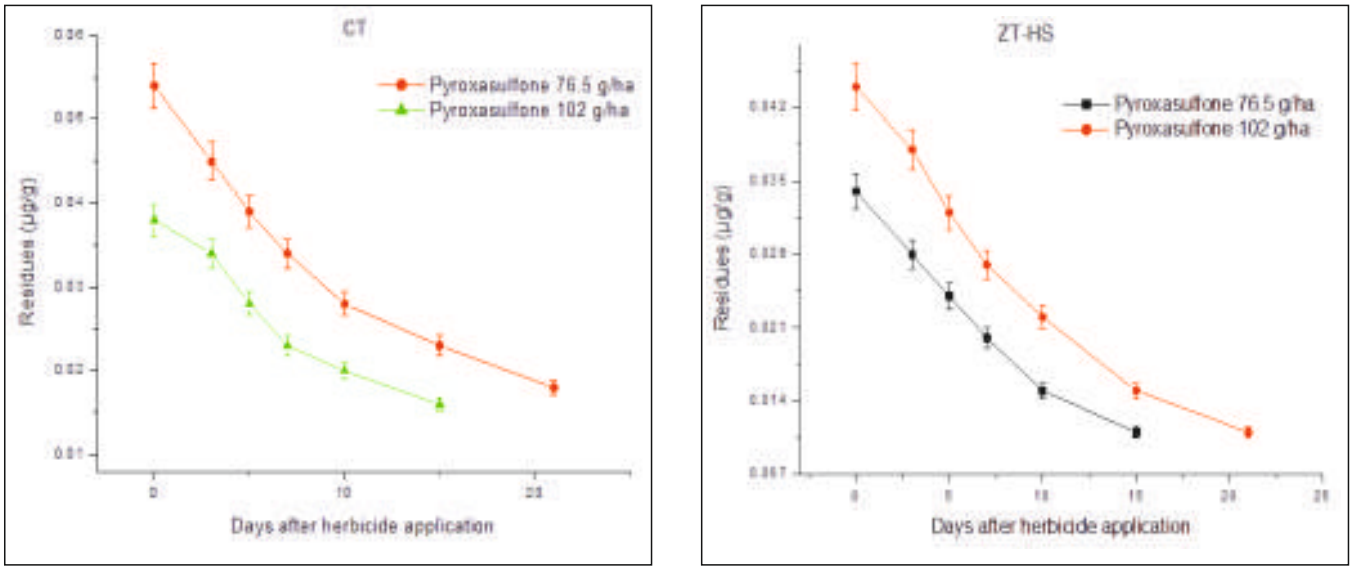


Figure 3.1.2 Residues of pyroxasulfone at studied application rates in CT and ZT-HS treatments

Table 3.1.1 Residues (µg/g) and half-lives (days) of pendimethalin and pyroxasulfone in CT and ZT-HS treatments at studied application rates

Treatments	Half-life		Residues in CT and ZT-HS in	
	CT	ZT-HS	Soil	Mustard
Pendimethalin 339 g/ha	20.21	17.43	<0.01	<0.05
Pendimethalin 500 g/ha	28.51	23.73	<0.01	<0.05
Pyroxasulfone 76.5 g/ha	11.38	8.88	<0.01	<0.05
Pyroxasulfone 102 g/ha	13.19	10.07	<0.01	<0.05

Conventional tillage (CT); Zero Tillage-Happy seeder (ZT-HS)

Soil samples were collected from the experiment on Integrated weed management in peas at 0 (3 hrs), 5, 7, 10, 15, 30, 45, 60, 90 days after spray from the experiment ST 1.1.15. Metribuzin, clodinafop and pendimethalin from soil were quantified by HPLC UV-visible detector. The residues of pendimethalin in soil at 0 day varied from 0.309 ± 0.07 to 0.321 ± 0.04 µg/g while for metribuzin, it varied from 0.073 ± 0.01 to 0.119 ± 0.06 µg/g in different treatments at studied application rates. DT_{50} of pendimethalin and metribuzin ranged from 21.44 to 32.12 and 8.89 to 25.56 days, respectively. The residues of metribuzin, pendimethalin and clodinofop in soil at harvest were below detectable.

At PJTSAU, Hyderabad, residues of atrazine, tembotrione and topramezone in soil and maize samples in maize-chick-pea cropping system were analysed *in Rabi 2022*. Soil samples were collected at 4 hours after herbicide application and at harvest. Grain, and straw samples (rice and maize) were collected at harvest for residue analysis. Fomasafen residues in the soil and soybean were analysed by HPLC/DAD whereas fluazifop residues in Chickpea grain were determined by gas liquid chromatography. In *Kharif* 2023, rice and maize were collected at harvest time. Atrazine was determined on GC-FTD. Topramezone and tembotrione was analysed by high performance liquid chromatography. Initial residues of atrazine at 3 hours after herbicide application varied from 0.344 to 0.362 µg/g in the soil samples. The persistence of atrazine in soil was noticed up to 60 days after application of the herbicide and at the time of harvest, the atrazine residues were below the detection limit of 0.05 µg/g. The residues of atrazine in the grain and plant samples at the time of harvest were below the detection limit of 0.05 µg/g **(Table 3.1.2).**

Table 3.1.2 Residues of atrazine in soil

Treatment	0	30	60	Harvest
M1: Atrazine + tembotrione (TM) (750 +120) g/ha as EPoE (15 DAS)	0.361	0.244	0.092	BDL
M2: Atrazine + topramezone (TM) (750 + 25.2) g/ha as EPoE (15 DAS)	0.382	0.277	0.101	BDL
M3: Atrazine + mesotrione (795+80g/ha) EPoE 15 DAS	0.311	0.256	0.097	BDL

The initial residues of the topramezone in soil was 0.014 to 0.017 µg/g however, tembotrione residues in soil varied from 0.022 to 0.031 µg/g. At the time of harvest, the tembotrione and topramezone residues in soil, grain and plant were below the detection limits (0.01 µg/g). At the time of harvest, the pendimethalin, imazethapyr, fomesafen, fluazifop and topramezone residues in soil, grain and plant were below the respective detection limits.

At UAS, Bengaluru, terminal herbicide residues were analysed in soybean. The concentration range of herbicides in all the soil samples analysed were below quantification limit (BQL) except pendimethalin (19.06 ug/kg) and sulfentrazone (8.62 ug/kg) **(Table 3.1.3).** The concentration of herbicides for all soybean seed samples analyzed were below quantification limit (BQL).

Table 3.1.3 Detected pesticides and their concentrations (ug/kg) in soil samples

Treatments	Dose (g /ha)	Formulation (g/ha)	Detected pesticide	Concentration (ug/kg)	LOQ (ug/kg)
Diclosulam 84% WDG as PE	26	30.95	BQL	BQL	5
Pendimethalin 30%+ imazethapyr 2%EC(RM) as PE	800	2500	>BQL	19.06	5
Sulfentrazone 28%+clomazone 30%WP(RM) asPE	725	1250	>BQL	8.62	5
Diclosulam84%WDG+pendimethalin 38.7% CS (TM) as PE	25.2+750	30+1938	BQL	BQL	5
Fluazifop-p-butyl 11.1% +Fomesafen 11.1% SL (RM) as PoE (20DAS)	250	1126	BQL	BQL	5
Bentazone 48%SL as PoE (20 DAS)	960	2000	BQL	BQL	5
Sodiumacifluorfen 16.5% + Clodinafop-propargyl8% EC as PoE (20DAS)	245	1000	BQL	BQL	5
Imazethapyr 3.75%+ propaquizafop 2.5% ME (RM) as PoE (20DAS)	125	2000	BQL	BQL	5

BQL – Below Quantification Limit (5 ug/kg); LOQ – Limit of Quantification (10 ug/kg)

At TNAU, Coimbatore, black gram soil samples were collected at 0,1,3,5,10,15,30,45 and 60DAHA from the herbicides applied plots in *Rabi*, 2022-23 and were subjected to respective residue analysis to find out the persistence and residue in soil. Pendimethalin, imazethapyr and clodinafop–propargyl residues were analysed by for HPLC determination. Residues of pendimethalin and imazethapyr persisted up to 60 and 45 DAHA respectively. Clodinafop–propargyl and acifluorfen-sodium were persisted up to 5 and 45 DAHA respectively. The half-life ranging from 3.7 to 20.9 days for all studied herbicides **(Table 3.1.4).** The residues of all the herbicides in soil, seed and haulm from different plots were below 0.01 mg/kg.

Table 3.1.4. Persistence of different herbicides in blackgram soil (*Rabi*, 2022-23) in rice- black gram cropping system

Herbicide	Residue (mg/kg)/ days										
	0 (2hr)	1	3	5	10	15	30	45	60	Harvest	$t^{1/2}$
Pendimethalin	0.512	0.462	0.407	0.356	0.294	0.235	0.124	0.067	0.036	<0.01	16.0
Imazethapyr	0.043	0.040	0.036	0.033	0.026	0.020	0.013	0.010	<0.01	<0.01	20.9
Clodinafop–propargyl	0.038	0.029	0.024	0.014	<0.01	<0.01	<0.01	NA	NA	NA	3.7
Acifluorfen-sodium	0.071	0.067	0.060	0.055	0.043	0.031	0.020	0.015	<0.01	<0.01	19.5

Rice soil samples were collected from the herbicides applied and hand weeding plots at 0, 1, 3, 5, 10, 15, 30, 45 and 60 DAHA and plant straw and grain were collected at harvest. Pyrazosulfuron-ethyl, bispyribac-sodium bensulfuron, penoxsulam, pretilachlor and cyhalofop-p-butyl residues were analysed in rice by HPLC. In *Kharif* 2023, the residues of herbicides were analysed at different intervals viz., 0, 10, 20, 30, 40, 50, 60 and 90 DAHA. The dissipation of all the herbicides was found to follow first order reaction kinetics (R^2>0.90) with the half-life of 10.8 to 11.3 days for pyrazosulfuron ethyl, 12.3 days for bispyribac sodium,14.6 days for cyhalofop-butyl, 12.0 days for penoxulum and 14.4 to 15.0 days for bensulfuron methyl. The residues of all the herbicides in grain and straw from different plots were below 0.01 mg/kg.

WP 3.2 Assessment of herbicide residues in the long-term experiments under program WP 1.2 Weed Management under conservation till age-based cropping

Network centres: PAU Ludhiana, CSKHPKV Palampur,

PJTSAU Hyderabad, TNAU Coimbatore, AAU Anand*, CCSHAU Hisar*, UAS Bengaluru*

At PAU-Ludhiana, pendimethalin and pinoxaden from soil and mustard samples was analysed by HPLC system. The residues of pendimethalin decreased successively over time and degradation of pendimethalin followed first order kinetics with R^2 > 0.98. The residues of pinoxaden and pendimethalin in soil (<0.01 µg/g) and mustard (<0.05 µg/g) at harvest were below detectable limit **(Figure 3.2.1)**.

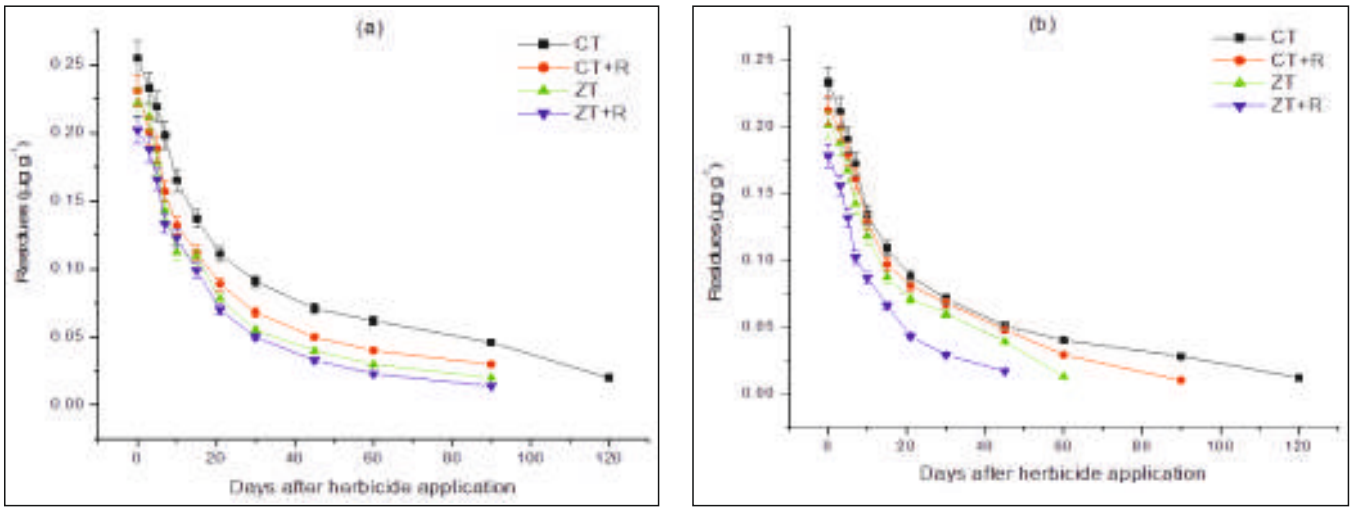


Figure 3.2.1 Residues of pendimethalin in (a) recommended (b) integrated weed management treatments in mustard

Table 3.2.1 Half-lives (days) and residues (µg/g) of pendimethalin in different treatments

	Half-life		Residues in RH and IWM	
Treatments	**RH**	**IWM**	**Soil**	**Mustard**
Conventional tillage (CT)	35.36	28.54	<0.01	<0.05
Conventional tillage-Residue retention (CT+R)	29.67	21.07	<0.01	<0.05
Zero tillage (ZT)	25.06	16.40	<0.01	<0.05
Zero tillage-Residue retention (ZT+R)	22.21	13.53	<0.01	<0.05

Recommended herbicide (RH); Integrated weed management (IWM)

Greengram

Pendimethalin and imazethapyr from soil and green gram samples were quantified using HPLC system. The initial residues of pendimethalin in greengram soil varied from 0.351 ± 0.167 to 0.367 ± 0.212 µg/g in CT and 0.251 ± 0.143 to 0.301 ± 0.123 µg/g in ZT treatments under recommended herbicide while in integrated weed management, initial residues varied from 0.261 ± 0.121 to 0.288 ± 0.126 µg/g in CT and 0.231 ± 0.139 to 0.251 ± 0.112 µg/g in ZT treatments. The initial residues of imazethapyr in soil varied from 0.287 ± 0.454 to 0.301 ± 0.323 µg/g in CT and 0.222 ± 0.144 to 0.262 ± 0.128 µg/g in ZT treatments under recommended herbicide treatment. The residues of pendimethalin and imazethapyr decreased successively over time. Degradation of pendimethalin and imazethapyr followed first order kinetics with R^2 > 0.98 and DT_{50} of pendimethalin and imazethapyr in different treatments is given in Table 3.2.2. The residues of pendimethalin and imazethapyr in soil and green gram were below detectable limit (<0.01 µg/g) at harvest **(Figure 3.2.2 and 3.2.3)**.

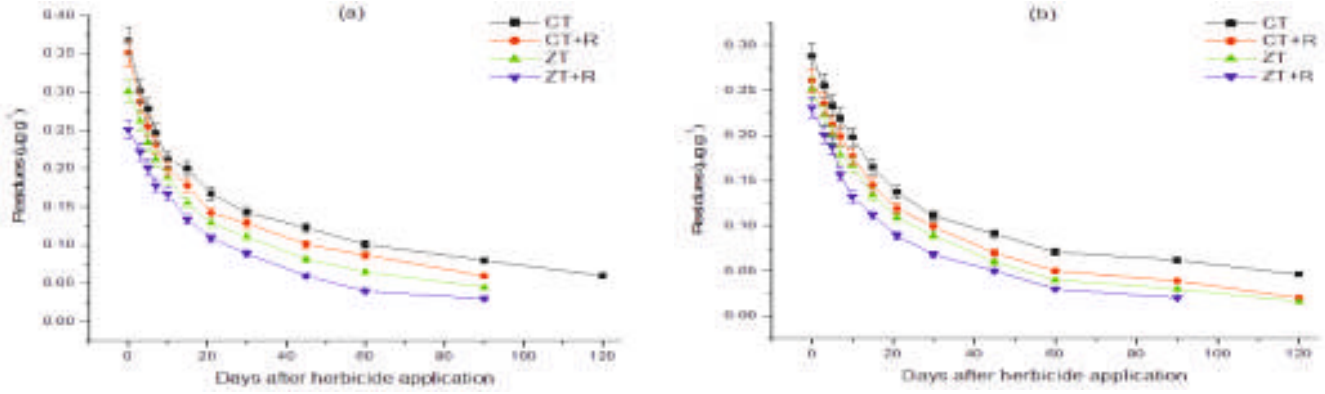


Figure 3.2.2 Residues of pendimethalin in (a) recommended (b) integrated weed management treatments in greengram

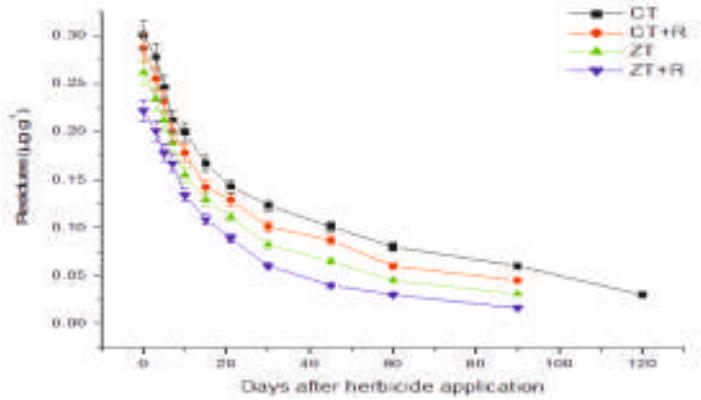


Figure 3.2.3: Residues of imazethapyr in recommended herbicide treatments in greengram

Table 3.2.2 Half-lives (days) of herbicides in different treatments in greengram

Treatments	Recommended herbicide		Pendimethalin in integrated weed management
	Pendimethalin	Imazethapyr	
Conventional tillage (CT)	48.52	39.28	44.20
Conventional tillage-Residue retention (CT+R)	43.26	33.70	33.33
Zero tillage (ZT)	37.53	28.73	28.11
Zero tillage-Residue retention (ZT+R)	30.63	23.07	24.92
Recommended CT/ZT+R (Green gram at harvest)			

Maize

Pyroxasulfone and topramezone from soil and maize were quantified using HPLC system. Under recommended herbicide treatments in maize, DT_{50} for pyroxasulfone in CT and CT+R treatments varied from 12.15 to 14.37 days while in ZT and ZT+R, it varied from 6.81 to 8.54 days. DT_{50} for tembotrione in CT and CT+R treatments varied from 9.17 to 11.16 days while in ZT and ZT+R, it varied from 4.93 to 6.37 days. Under integrated weed management treatments in maize, DT_{50} for atrazine in CT and CT+R treatments varied from 22.00 to 26.35 days while in ZT and ZT+R, it varied from 15.31 to 19.40 days. DT_{50} for topramezone in CT and CT+R treatments varied from 9.17 to 11.16 days while in ZT and ZT+R, it varied from 3.31 to 6.37 days. The residues of pyroxasulfone, tembotrione, atrazine and topramezone in soil and maize at harvest were below detectable limit (<0.01 µg/g). The chromatograms of herbicides at different days and harvest in soil and crop produce is given in **Figure 3.2.4**.

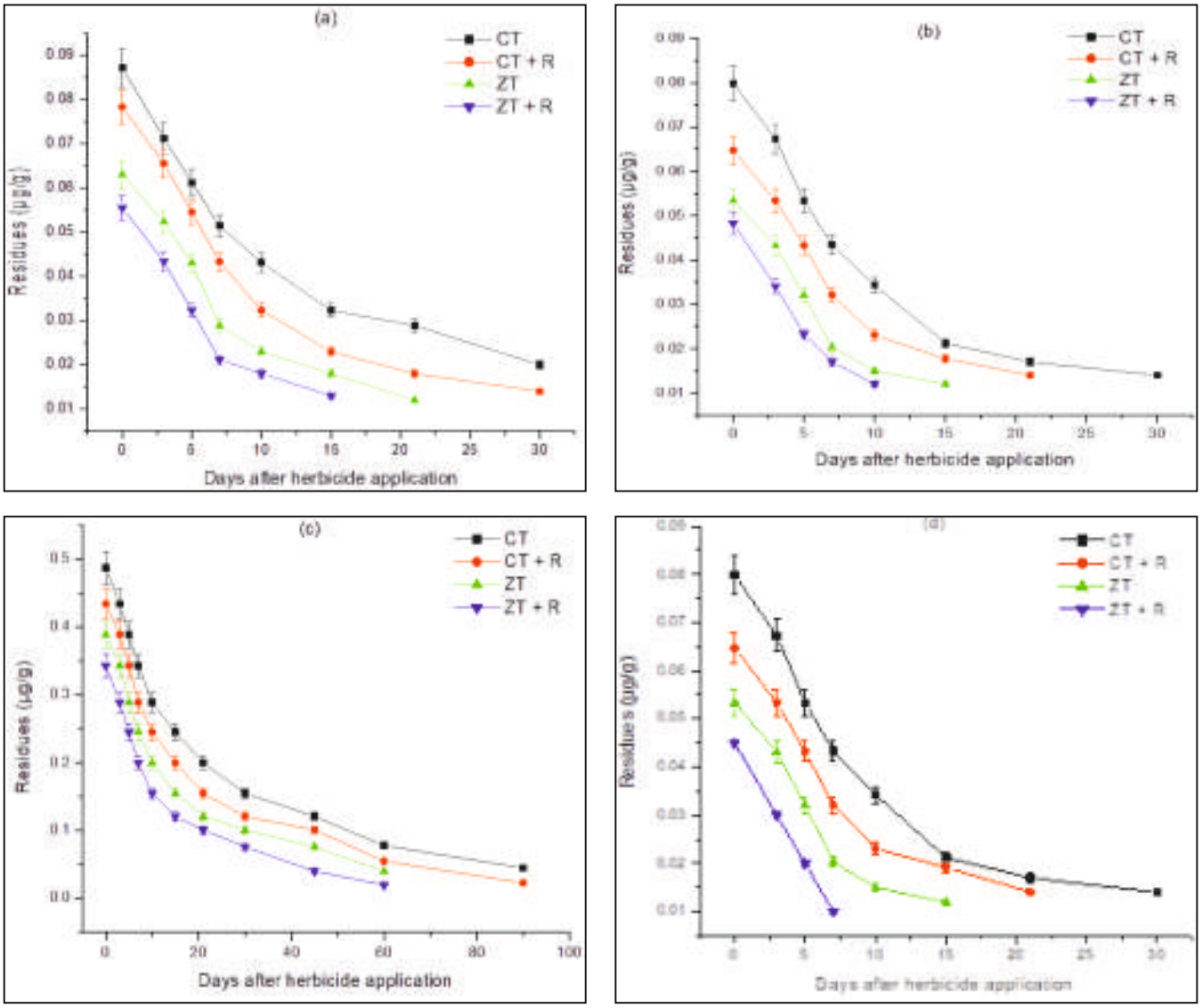


Figure 3.2.4 Residues of (a) pyroxasulfone (b) tembotrione in recommended treatments and (c) atrazine (d) topramezone in integrated weed management treatments in maize

Rabi 2021-22 and *Kharif* 2022, no significant changes in soil physico-chemical properties were recorded as impacted by different tillage and weed management options after the maize crop harvest in cotton- maize-green manure conservation agriculture experiment at PJTSAU, Hyderabad. However, there was a significant increase in organic carbon content of the soil in Zero-till treatments compared to the conventionally tilled treatment. The increase in OC content of the soil was significant. Similarly, there was a significant increase in available nitrogen content of the soil in zero-till treatments compared to CT-CT and CT-ZT treatments. Therefore, the interaction was also non-significant. However, in case of weed management treatments, the increase in organic carbon content in the unweeded plots was found to be significantly higher than the chemical weed management treatments and IWM treatment. The interaction of tillage and weed management practices was also non-significant.

At 4 hours after herbicide application, initial residues of atrazine varied from 0.394 to 0.422 µg/g in the soil samples. In the final soil sample, and maize grain/ plant samples collected at the time of harvest, the atrazine residues were below the detection limit of 0.05 µg/g in all the soil samples. Initial residues of diuron at 4 hours after herbicide application varied from 0.214 to

0.341 µg/g in the soil samples. In the final soil sample at the time of harvest, the diuron residues were below the detection limit of 0.05 µg/g in all the soil samples. Whereas, initial residues of pendimethalin and quizalofop ethyl at 4 hours after herbicide application varied from 0.511 to 0.528 µg/g and 0.040 to 0.053 µg/g in the soil samples. Persistence of pendimethalin soil could be noticed up to 60 days after pre-emergence application in soil. In the final soil sample at the time of harvest, the pendimethalin and quizalofop ethyl residues were below the detection limit of 0.05 µg/g in all the soil samples.

At TNAU, Coimbatore, baby corn was grown as test crop which received atrazine as pre-emergence herbicide, and tembotrione and topramezone and 2,4-D as early post emergence herbicide during *Rabi* 2022-23. Soil samples were collected from herbicide applied plots on 0, 3,7,15, 30, 45 and at harvest to find out the persistence and residue in soil as influenced by the tillage and residue management practices. Atrazine, tembotrione and 2, 4-D residues were analysed by HPLC. Residues of different herbicides applied in babycorn was analysed at different period *viz*., 0, 3, 7, 15, 30, 45 and at harvest. Lower residues were detected in the zero tillage with and without residue plots when compared to conventional tillage. The half-life of 16.0 - 17.9 days for atrazine, 10.4 -11.4 days for tembotrione, 9.9 to 10.5 days for topramezone and 8.5 to 9.15 days for 2, 4-D irrespective of tillage practices and weed management methods was found. The residues of 2, 4-D, tembotrione, topramezone and atrazine 0.5 kg/ha in soil and baby corn from different plots were below 0.01 mg/kg irrespective of the tillage and weed management practices followed for weed control. Whereas, application of atrazine at 1.0 kg/ha recorded residues of 0.023 to 0.038 mg/kg in soil at harvest.

WP 3.3 Assessment of herbicide residues in high value crops

Network centres: PAU Ludhiana, CSKHPKV Palampur, PJTSAU Hyderabad, TNAU Coimbatore, AAU Anand*, CCSHAU Hisar*, UAS Bengaluru*, BCKV Kalyani*)

At PAU-Ludhiana, field experiment was conducted at farmer's field at village *Akalgarh* (75°38'50.80'' 30°45'8.28'') to estimate the residues of metribuzin applied to potato. Two sequential application of Metribuzin 70% WP) were done at 1st of November, 2022 and 15th of November, 2022, respectively at 250 mL/acre. Soil samples were collected from the field at 3 hrs after second spray for determination of residues of metribuzin. Metribuzin from soil samples were quantified using HPLC. The initial residue of metribuzin was 0.521 µg/g in soil. The degradation data of metribuzin fitted well to first order kinetics with R^2>0.97 with DT_{50} of 19.57 days. The residues of metribuzin in soil and potato at harvest were below detectable limit (<0.01 µg/g) **(Figure 3.3.1).**

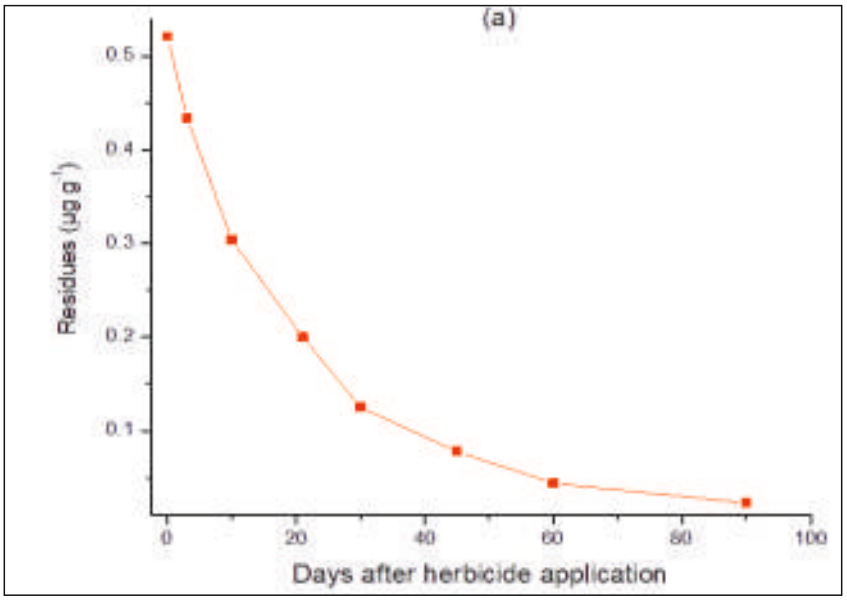


Figure 3.3.1 (a) Residues of metribuzin at different time intervals in soil

WP 3.4 Assessment of herbicide residues under programme WP 4. Demonstration and impact assessment of weed management technologies and SCSP

Soil, water and crop samples were collected randomly at harvest from farmer's fields from Ludhiana, Moga, Kapurthala, Fazilka and Sangrur districts of Punjab in rice-wheat cropping system. Pretilachlor, butachlor, anilofos, bispyribac-sodium, pendimethalin, penoxsulam, sulfosulfuron, metsulfuron-methyl, pinoxaden, clodinafop, mesosulfuron methyl + iodosulfuron-methyl sodium were commonly used herbicide in these districts. Residues of these herbicides and some of their transformation products *viz.* their transformation products (TPs) *viz.* 2-amino-4,6-dimethoxypyrimidine (ADMP), 4,6-dimethoxypyrimidine-2-yl-urea (DMPU), methyl 2-(aminosulfonyl) benzoate (MASB) and 2-amino-4-methoxy-6-methyl-1,3,5-triazine (AMMT) were estimated by HPLC.The residues of these herbicides in soil, water and crop produce samples collected at harvest were below detectable limits (<0.01 µg/g). The residues pendimethalin + penoxsulam, pinoxaden + metribuzin, clodinafop + metribuzin and pyroxasulfone in samples of soil, water and crop produce collected from OFR and FLD trials at harvest were below detectable limit (<0.01 µg/g). The soil and crop produce samples were collected from eighteen farmer's field with known history of herbicide application in different districts of Punjab.

At PJTSAU, Hyderabad, metribuzin residues in tomato samples were below the detection limit (0.05 mg/kg) in all samples. At the time of harvest of beetroot soil samples and tuber samples were collected from the experimental field in Ranga Reddy district. Pendimethalin residues in soil was analysed by Gas Chromatograph. In the soil samples and beetroot samples, pendimethalin residues were BDL (0.05 mg/kg). At TNAU, Coimbatore, metolachlor residues in the soil were ranged from 0.598 to 0.684 (µg/g) at 0 DAHA. At harvest metolachlor residues in the soil and cauliflower curd samples of above four locations at harvest were below the detection limit of <0.01(µg/g).

WP 3.4. Assessment of herbicide residues in farmers' field

Herbicides residue in soil and ground water sample from farmer's field

In Tirupur and Coimbatore district soil and ground water samples were collected from various field where herbicides are being continuously used more than 10 years for weed control. The result indicated that none of the applied herbicides were detected in the soil and water of all the locations **(Table 3.4.1)**. This showed that they have been degraded from the soil before the harvest of the crop.

Table 3.4.1. Herbicides residue in soil and ground water sample from farmer's field

Name of the farmer	Crops grown	Herbicide used	Soil (µg/g)	Ground water Open well / borewell (µg/g)
Mr. Nanjan	Rice	Pretilachlor 1 kg/ha	BDL	BDL
Pattiar pathi Kovil	Black gram	Pendimethalin 1 kg/ha	BDL	BDL
Narasipuram		Quizalofop ethyl		
	maize	Atrazine 0.5 kg/ha,	BDL	BDL
		Tembotrione 120 g/ha		
Mr. Perumal	Maize	Atrazine 625 g/ha	BDL	BDL
Mukkonam	Onion	Oxyfluorfen 0.25 kg/ha	BDL	BDL
Udamalpet		Quizalofop ethyl		
D. K.Ramasamy	Onion	Oxyfluorfen 0.25 kg/ha	BDL	BDL
S/o.karrupannan	Gourd vegetable	Pendimethaliin 0.75 kg/ha	BDL	BDL
Thondamuthur	Brinjal/tomato		BDL	BDL
Mr. Kalisamy	Maize	Atrazine 0.5 kg/ha	BDL	BDL
S/o. Appavu goundar	Onion	Oxyfluorfen 0.25 kg/ha	BDL	BDL
Nathegoundan pudur		Quizalofop ethyl	BDL	BDL

WP 4 Demostration and impact assessment of weed management technologies & SCSP

WP 4.1: On-Farm Research trials

TNAU, Coimbatore

During *Kharif 2023*, five OFTs were conducted with the aim of demonstrating Integrated Weed Management practices in groundnut at farmers' fields with local varieties of groundnut in Kinathukadavu taluk, Coimbatore District. Manual weeding is commonly followed by farmers to control weeds in groundnuts. However, manual weeding is challenging and unprofitable due to shortages and high wages of labour, particularly during peak season and early crop-weed competition. Herbicides (imazethapyr + quizalafop-ethyl (50+50 g/ha) *fb* HW; propaquizafop + imazethapyr 125 g/ha and pendimethalin 1 kg/ha *fb* hand weeding) were found best for the management of weeds.

PAU, Ludhiana

Five OFTs on weed management in DSR were conducted with pendimethalin 24% + penoxsulam 1% (RM) at 2500 g/ha in comparison with pendimethalin 30EC at 2500 g/ha (standard). Pendimethalin + penoxsulam (RM) at 2500 ml/ha provided effective control of broad-spectrum weeds and provided an early weed free environment to DSR at early stages. New ready-mix provided rice grain similar to pendimethalin 2500ml/ha (on an average 7.5 t/ha) however both had significantly higher yield than unsprayed check at all locations. Five OFTs on weed management in wheat were conducted with tank-mixture of pinoxaden + metribuzin at 225 g/ha which was compared with ready mixture of clodinafop + metribuzin 174 g/ha (standard). Tank-mixture of pinoxaden + metribuzin recorded effective control of *P. minor* and provided similar weed control and wheat grain yield (on an average 5.4 t/ha) to ready mixture of clodinafop + metribuzin at all locations

CCSHAU, Hisar

The efficacy of different pre-emergence herbicides followed by post-emergence herbicides against resistant populations of *P. minor* was assessed at farmers' fields at five locations in different districts. Application of pre-emergence pyroxasulfone + pendimethalin (TM) at (127.5 + 1500 g/ha) followed by PoE application of metribuzin just after irrigation followed by pinoxaden + metribuzin provided 97% control of *P. minor* resulting more effective tillers/m^2 and grain yield of wheat (5.61 t/ha) followed by sequential application of pyroxasulfone + pendimethalin (TM) at (127.5 + 1500 g/ha) *fb* pinoxaden + metribuzin 50 g/ha (5.42 t/ha). Alone application of pinoxaden + metribuzin provided 66% control of *P. minor* with grain yield 5.04 t/ha.

KAU, Thrissur

On-farm research trials on the management of *Limnocharis flava* in rice were conducted at four locations. The three treatments were Post-emergent application of 2,4-D Na salt 1.0 kg/ha 18-20 DAS, penoxsulam + pendimethalin, 625 g/ha, 20 DAS and (Farmer's practice)-hand weeding. It was found that the penoxsulam + pendimethalin, 625 g/ha, 20 DAS resulted in the highest average grain yield of 4.71 t/ha, whereas the lowest average weed dry matter at harvest was recorded for the 2,4-D Na salt 1.0 kg/ha treatment (25.33 g/m^2).

SKUAST, Jammu

Two on-farm research on weed management in transplanted rice were conducted in *Kharif* 2023 at farmer's fields in Jammu region under irrigated conditions. The two test treatments *viz.*, triafamone + ethoxysulfuron 66.5 g/ha at 25 DAT and cyhalofop-butyl + penoxsulam 135 g/ha post at 25 DAT were evaluated and compared with bispyribac-sodium 25 g/ha at 25 DAT as Farmer's practice in two locations. All the herbicides were applied at 25 DAT using 500 L water/ha. Lower weed density, higher grain yield and B: C were recorded under treatments (triafamone + ethoxy-sulfuron 66.5 g/ha at 25 DAT and cyhalofop-butyl + penoxsulam 135 g/ha post at 25 DAT) as compared to farmer's practice. The new herbicidal interventions i.e triafamone + ethoxysulfuron 66.5 g/ha at 25 DAT and cyhalofop-butyl + penoxsulam 135 g/ha post at 25 DAT recorded 11.13% and 15.51% higher mean yield as compared to farmer's practice (bispyribac-sodium 25 g/ha at 25 DAT), respectively.

IGKVV, Raipur

Twenty five OFR trials were conducted on weed management in direct seeded rice with treatment applications of pre emergence application of pyrazosulfuron 20 g/ha at 0-7 DAS *fb* bispyibac- Na 25g/ha at 20 DAS (T_1) and pyrazosulfuron 20 g/ha *fb* penoxsulam +cyhalofop-butyl 135g/ha (T_2) as technology transfer farmer's practice (T_3) i.e., use of bispyribac-Na 25g/ha at 20 DAS. The average grain yield obtained under improved weed management technology treatments were 5.21 and 5.39 t/ha as compared to the farmer's practice (4.43 t/ha) in two trial locations. However, percent increase under WM technology (T2) and recommended practice (T1) was 21.92 and 17.91 % respectively over farmers practice (T3). The average benefit cost ratio was appreciably higher (3.45 and 3.51) as compared to the farmers' practice (3.09).

AAU, Anand

Two OFRs were conducted in soybean with treatments *viz.* propaquizafop 2.5% + imazethapyr 3.75% w/w ME (premix) *fb* IC + HW at 40 DAS (T_1), quizalofop ethyl 7.5% + imazethapyr 15% w/w EC (premix) *fb* IC + HW at 40 DAS (T_2) and Farmers' practice (IC *fb* HW at 20 and 40 DAS) (T_3). The result indicated that T_1 was more effective in controlling the weeds and it has a net return of Rs. 47,131/ha, benefit-cost ratio of 2.19 and lowes weed dry weight (85.6 g/m^2) at harvest.

RVSKVV, Gwalior

Two OFRs were conducted on green gram at farmer's fields in two villages of Gwalior district in *summer* 2023. Herbicides pendimethalin + imazethapyr (RM) 750 g/ha as PE and Imazethapyr + imazamox (RM) 50 g/ha as PoE were tested on summer green gram and compared with farmer's practices where farmer was not applied any herbicide. The dominant weeds on farmer's field were *Cyperus rotundus, Phyllanthus niruri, Echinocloa crus-galli, Commelina benghalensis, Digera arvensis* and *Seteria glauca*. It was observed that both the chemical weed management practices gave higher grain yield over farmer's practice. The maximum yield of greengram (841 kg/ha) with BC ratio (3.41) was obtained with the application of Imazethapyr + imazamox (RM) 50 g/ha as PoE *fb* pendimethalin + imazethapyr (RM) 750 g/ha as PE which was 38.10%, and 34.15% higher over farmer's practices respectively. The yield of farmer's field was very low which was 0.61 t/ha with BC ratio 2.57.

UAS, Bengaluru

Five on-farm research trails were conducted on weed management in Foxtail millet during *Kharif* 2023. The three treatments were; metsulfuron Methyl + chlorimuron ethyl WP-20 WP (2+2) 4 g/ha (T_1), 2, 4 D sodium salt 80 WP 1000 g/ha (T_2) and One inter cultivation and hand weeding at 20 and 40 DAS (T_3). hand weeding at 20 and 40 DAS provided the highest seed yield and lowest weed dry weight. However, T_1 recorded seed yield and weed dry weight figures very much close to that of T_3. The centre carried out seven OFRs on weed management in Field bean. The treatments were; diclosulam 84 WDG @ 22 g a.i./ha (T_1),: imazethapyr 10% SL + surfactant @ 75 g a.i./ha (T_2) and Hand weeding at 20 and 40 DAS (T_3). The results showed almost on par green pod yield in case of both T_1 and T_3 whereas total weed dry weight was lowest in T_3 compared to other two treatments. The centre also carried out five OFRs in Soybean and the three treatments were; diclosulam 84 WDG @ 22 g a.i./ha (T_1), fluazifop-p-butyl 11.1% + fomesafon 11.1% SL @ 150 g a.i./ ha (T_2) and Hand weeding at 20 and 40 DAS (T_3). The result indicated a much lower weed dry matter in case of T_3 while seed yield of T_1 and T_3 did not show much difference.

CSKHPKV, Palampur

Six OFTs on rice, seven on wheat, eight on maize, six on peas, five on soybean and four on turmeric were undertaken. The results were encouraging and showed that the treatment pyrazosulfuron 2.0 g/ha (PE) *fb* bispyribac Sodium 20 g/ha (30 DAS) provided the highest grain yield (4.1 t/ha) in rice and clodinafop 60 g/ha + metsulfuron methyl 4 g/ha gave highest yield (3.8 t/ha) in wheat. In maize, tembotrione – 120 g/ha + atrazine-0.5g/ha (20-30 DAS) gave the highest yield being 30% higher over the farmers' practice of hoeing and hand weeding 20 and 45 days after sowing. In peas, imazethapyr 100 g/ha + HW increased peas yield by 22.5% over the farmers' practice of hand weeding thrice whereas pendimethalin 1.50 kg/ha + HW increased peas pod yield by 15% over the farmer's practice. Treatment imazethpyr gave greatest yield of 1.4 t/ha followed by 1.3 t/ha under quizalofop-ethy + chlorimuron-ethyl and in turmeric, atrazine *fb* mulch *fb* HW gave maximum yield of 10.1 t/ha followed by metribuzin with 9.5 t/ha which was 1.9 and 1.3 t/ha more, respectively over the farmers practice of mulch + HW only.

MPUAT, Udaipur

Two OFRs on broad spectrum weed control in wheat with premix application of carfentrazone + sulfosulfuron (245 g/ha) at 30 DAS, pinoxadone + metsulfuron (40 + 4 g/ha)and sulfosulfuron + MSM (30+2 g/ha) as Farmers practice at 30 DAS were conducted in two villages. The farmer's field was infested with *Phalaris minor* among the monocots *Chenopodium album, Chenopodium murale, Convolvulus arvensis, Fumaria parviflora,* and *Melilotus indica* were observed among dicots. Both the farmers were highly impressed with the weed control performance of herbicide. Application of ready-mix herbicide carfentrazone + sulfosulfuron (245 g/ha) at 30 DAS. It was recorded minimum weed density and weed dry matter as compared to farmers practice with increased the wheat grain yield by 23.37 per cent over farmers practice wheat yield (3.65 t/ha).

Two OFRs on weed management in maize through post emergence herbicide Tembotrione and topramezone with atrazine was conducted by the centre. Minimum weed density and weed biomass was recorded with the EPoE application of atrazine with topramezone (500+ 25.2 g/ha) and it followed by atrazine with tembotrione 500 + 120 g/ha as EPoE at 3-4 leaf stage (20 DAS) in maize. It also showed mild phyto-toxicity symptoms on crop but crop recovered after some days. The major broadleaf weeds in the OFR fields were *Trianthema portulacastrum and Digera arvensis.* The grassy weeds were *Echinochloa colona, Commelina bengalensis and Cyperus rotundus. Parthenium hysterophorus* is a perennial weed and most problematic weed in the cropped and non-cropped field. Maximum value of grain and straw yield was obtained with the application of atrazine+ topramezone (500+ 25.2 g/ha) at 3-4 leaf stage (15 DAS) by increasing 12.30 percent over farmers practice of application of atrazine followed by interculture operation at 35 DAS in respect of grain yield of maize.

Two OFR trials on weed management in soybean to understand and compare the weed management performance through herbicide acifluorfen + clodinafop propargyl at 245 g/ha, imazethapyr + propaquizafop (RM) 125 g/ha PoE at 21 DAS (TM) and imazethapyr 75 g/ha followed by one hand weeding at 35 DAS was also conducted. The treatments included the imazethapyr 75 g/ha followed by one hand weeding at 35 DAS *i.e.*, farmers practices to compare the efficacy over the farmer's practices and weed check. The minimum density and dry matter of total weeds was recorded with the treated plot. The maximum seed (682 kg/ha) and haulm yield (1.8 t/ha)

of soybean over farmers practice was observed with tank mix application of imazethapyr + propaquizafop 125 g/ha at 21 DAS. The maximum net returns (Rs. 21000/ha) was realized with imazethapyr + propaquizafop.

BUAT, Banda

Seven OFTs on rice were carried out in farmer's fields located in Banda district during the *Kharif* season of 2023, with three different treatments *viz.* penoxsulam 20 g/ha at 20-25 DAS (T_1), bispyribac sodium 25 g/ha as PoE (20 -25 DAS) (T_2) and Farmer's practice (two hand weeding) (T_3). Maximum weed population at both the stages of observations were recorded under farmer's practice (two hand weeding), while minimum under T_1-Penoxsulam 20 g/ha at 20-25 DAS. Weed density at 25 DAS was ranged between 15.1 -21 and at 60 DAS between 30.5 – 40.9 per square meter. Seven OFRs on wheat also conducted by the centre. Sulfosulfuron + metsulfuron-methyl 30g + 2g/ha 30 DAS, Clodinafop+ metsulfuron (0.06+0.004) kg/ha PoE (25-30 DAS) and Farmer's practices (Manual weeding) were the three treatments applied. Average weed population under all treatments were observed as almost equal due to non-application of treatments at 25 DAS. While minimum weed population was recorded under T_1- Sulfosulfuron + metsulfuron-methyl (30+2) g/ha 30 DAS and maximum under farmers practice was observed at 60 DAS. Mean grain yield of wheat from all seven locations was recorded higher (3.43 t/ha) with application of Sulfosulfuron + metsulfuron-methyl 30g + 2 g/ha 30 DAS followed by Clodinafop + metsulfuron (0.06+0.004) kg/ha PoE at 25-30 DAS (3.35 t/ha) which was 9.9 % and 7.4 % higher over farmer's practices (3.12 t/ha).

OUAT, Bhubaneswar

Four OFTs on transplanted rice were conducted during *Rabi* 2022-23 at Nayagarh and Kendrapara districts. Maximum yield of 4.1 t/ha was recorded in the plot applied with Pretilachlor+pyrazosulfuren (0.615 kg/ha) followed by oxadiargyl 75 g/ha (3.4 t/ha). A net saving of Rs. 2450 - 2550/ha was obtained in the plots treated with herbicides. Further, four OFTs on *Kharif* -2023 rice were conducted in Nimapada, Delanga, Puri area. The highest yield was obtained in the plots applied bispyribac- Na (0.025 Kg/ha) (4.5 t/ha) followed by pretilachlor 0.75 kg/ha (4.3 t/ha). The saving in weeding cost over farmers practice was in the tune of Rs 2600 to Rs 2950 / ha.

PDKV, Akola

Two OFTs on soybean were conducted at farmers' fields in which two weed management technologies were compared with farmer's practice (1 Hoeing and 2 Hand weeding). Higher yield and weed control were recorded with the application of propaquizafop 2.5% + imazethapyr 3.75% (RM) in comparison with the farmer's practice. Higher yield of soybean was recorded with application of propaquizafop 2.5% + imazethapyr 3.75% (RM) over imazethapyr 10% SL with a benefit-cost ratio of 2.80. Further, two OFTs on cotton were conducted with three treatments *viz*. Pendimethalin 30 EC as PE 1.00 kg/ha *fb* directed spray (by using protective shield) of Paraquat 24 SL 0.60 kg /ha at 45 days after sowing (T_1), Pyrithiobac Sodium 10% EC (T_2) and Farmer practice (2 Hoeing 10 days interval and 2 Hand weeding) (T_3). The results indicated that application of pre-emergence herbicdes pendimethalin *fb* directed spray of paraquat out yielded over alone application of pyrithiobac as post-emergence herbicides. This might be due to management of wider weed spectrum with sequential application of pre-emrgence pendimethalin *fb* directed application of paraquat dichloride. Higher gross monetary return was reported in farmers practice, however, higher net monetary returns and B:C were reported by application of pre-emrgence pendimethalin *fb* directed application of paraquat dichloride.

PJTSAU, Hyderabad

On-farm research trials were conducted to identify effective weed management practice for *Striga* control in sugarcane. The treatments applied were; T_1: Soil application of UASDAMF consortium 20 kg/ha mixed with 500 kg of vermicompost, T_2: TNAU package (post-emergence spraying of 2,4-D @ 6 g (0.6%) + Urea @ 20 g (2%) / litre of water at 90 DAP + Trash mulching 5 t/ha at 120 DAP) and T_3: Farmers' practice (atrazine @ 1.0 kg/ha at 3 DAP (PE) *fb* directed application of glyphosate @ 10 ml/lit at 45 DAP *fb* one HW at 90 DAP). The result was reported as no incidence of *Striga* in any of the treatments.

GBPUAT, Pantnagar

Five on-farm research trials were conducted on wheat crop at farmer's field during *Rabi* season of 2022-2023. The area of each treatment was 2000 m^2 and the wheat variety HD-2967 was seeded. Trial comprised of carfentrazone + sulfosulfuron (20+25 g/ha) at 28-35 DAS (BROADWAY) and clodinafop-propargyl + metribuzin (54+120 g/ ha) 175 g/ha at 28-35 DAS (ACM-9) were improved technology. Sulfosulfuron (25g/ha) at 28-35 DAS were taken as farmer's technology. These three treatments were compared with weedy check for yield loss estimation. The major weeds infested the weedy check plots were *Phalaris minor, Rumex acetosela, Madicago denticulata, Vicia sativa, Solanum nigrum, Melilotus indica, Anagallis arvensis, Coronopus didymus & Chenopodium album.* An average increase in grain yield due to adoption of improved technology was 18.8% higher than farmer's technology. Application of carfentrazone + sulfosufuron (20+25 g/ha) at 28-35 DAS recorded highest grain yield 5.0 t/ha, net return Rs. 577590.0/ha and B:C 2.36 followed by clodinafop propargyl + metribuzin (54+120 g/ha) 175 g/ha at 28-35 DAS which attained grain yield 4.5 t/ha, net return Rs. 54521.0/ha & B:C 2.29 which were higher over farmer's technology.

Three OFR trials were conducted at different locations of farmer's field in Distt. Udham Singh Nagar, Uttarakhand during *Kharif* season 2023 to evaluate the performance of different herbicidal treatments. The trial was consisted of penoxsulam 0.97 % + butachlor 38.8 % SE 820 g/ha (PE), penoxsulam 1.02 % + cyhalofop-butyl 1.1 % OD, 135 g/ha (PoE) as improved technology, whereas, pretilachlor 50% EC 750 g/ha (PE) was applied as farmer's technology and weedy check was taken to estimate the yield loss caused by weeds. The plot size of each treatment was 2000 m^2 and rice variety HKR-47 was transplanted. The major weeds infested the weedy plots were *Echinochloa colona, Leptochloa chinensis, Panicum maximum, Digitaria sanguinalis, Ammania baccifera, Commelina benghalensis, Cyperus rotundus* and *Cyperus iria.* The reduction in grain yield due to uncontrolled weeds was 20% in weedy check plot while an increase in grain yield with penoxsulam 0.97% butachlor 38.8% SE 820 g/ha and penoxsulam + cyhalofop-butyl 135 g/ha (PoE) was 12.5% over farmer's technology. Among different weed management treatments, highest grain yield 4.53 t/ha, net return Rs. 54752.0/ha and B:C 2.23 was achieved with - penoxsulam 0.97%+ butachlor 38.8% SE 820 g/ha (PE).

Two OFR trials on soybean were conducted at farmer's field during *Kharif* season of 2023 in Distt. Nainital. The area of each treatment was 2000 m^2 and soybean variety PS-1225 was seeded. The trial comprised of sodium acifluorfen 16.5%+ clodinafop propargyl 8%

EC 165+80 g/ha (POE), fluazifop-p-butyl 11.1% w/w+ fomesafen 11.1% w/w SL 250 g/ha (POE) as improved technology whereas pretilachlor 50 EC 750g/ha PE was farmer's technology. Post-emergence herbicide was applied by using 500 litres of water/ha with flat fan nozzle. The major weeds found in weedy check plots were *Digitaria sanguinalis, Dactyloctenium aegyptium, Eleusine indica, Trianthema monogyna, Mollugo pentaphylla, Celosia argentea, Alternanthera sessilis, , Digera arvensis* and *Cyperus rotundus*. Reduction in average grain yield of soybean due to weeds in weedy check plots was 34.7% in comparison to recommended practice. An increase in grain yield with improved technology was found 6.5 %. The highest grain yield 2.5 t/ha, net return Rs. 82563.0/ha and B:C 3.62 were recorded with fluazifop-p-butyl 11.1% w/w+ fomesafen 11.1% w/w SL 250 g/ha 20 DAS.

Two OFR trials on maize were conducted at farmer's field during *Kharif* season of 2023 in Distt. Nainital. The area of each treatment was 2000 m^2 and the maize variety P3378 was seeded. The treatments comprised of atrazine 500 g/ha+ topramezone 25.2 g/ha (TM) and atrazine 500 g/ha+ tembotrione 120 g/ha (TM) under recommended technology, whereas, tembotrione 120 g/ha was farmer's technology. The major weeds infested the field in weedy check plots were *Eleusine indica, Echinochloa colona, Panicum maximum, Digitaria sanguinalis*, *Celosia argentea, Trianthema monogyna* and *Cyperus rotundus.* The reduction in cob yield due to uncontrolled weeds was 36.1% in weedy check plot while an increase in cob yield with atrazine 500 g/ha + topramezone 25.2 g/ha (TM)(20 DAS) and atrazine 500 g/ha + tembotrione 120 g/ha (TM) (20 DAS) was 21.4% over farmer's technology. Among different weed management treatments, highest cob grain yield 6.1 t/ha, net return Rs. 89315.0/ha and B:C 3.34 were achieved with atrazine 500 g/ha+ topramezone 25.2 g/ha (TM).

Two OFR trials on sugarcane were conducted at farmer's field during *Spring* season of 2023 in Distt. Udham Singh Nagar. The area of each treatment was 2000 m^2 and the cane variety Co-0238 was planted. The treatments were comprised of ametryne 80 WDG 2.0 kg/ha PE and mesotrione 2.27 % + atrazine 22.7 % SC 875 g/ha PE under recommended technology, whereas 2,4-D dimethyle amine salt 58 % SL 2.5 kg/ha at 30 DAS was taken as the farmer's technology. The major weeds infested the field in weedy check plots were *Sorghum halepense*, *Digitaria sanguinalis, Eleusine indica, Alternanthera sessilis, Ipomoea* spp, *Parthenium histophorus, Ageratum conyzoides,* and *Cyperus rotundus.* The reduction in cane yield due to uncontrolled weeds was 31.3% in weedy check plot while an increase in grain yield with ametryne 80 WDG 2.0 kg/ha (PE) and mesotrione 2.27 % + atrazine 22.7 % SC 875 g/ha (PE) was 6.8% over farmer's technology. Among different weed management treatments, highest grain yield 100.5 t/ha, net return Rs. 259725.0/ha and benefit-cost ratio 3.99 were achieved with mesotrione 2.27 % + atrazine 22.7 % SC 875 g/ha (PE).

BCKVV, Kalyani

Four OFR trials were conducted in Maize at Village. Dominated weed flora in the study area was comprised of *Cynodon dactylon, Setaria glauca, Echinochloa colona among grasses, Cyperus rotundus* among sedges and *Chenopodium album, Ageratum conyzoides, Alternanthera phyloxeroides, Euphorbia hirta, Phyllanthus niruri, Physalis minima, Tridax procumbens etc.* among broad leaved weeds. Data revealed that among the weed management practices, topramezone+atrazine (25.2+500 g/ha) EPoE *fb* IC + HW at 40DAS recorded minimum density and dry weight of grass, sedge and broad-leaved weeds throughout the crop growth period. The second best result was observed with the application of tembotrione +atrazine (120+500 g/ha) EpoE *fb* IC + HW at 40DAS and was followed by the Farmers' practice (HW at 20 and 40DAS). The highest cob length and cob girth of about 18.93cm and 15.53 cm was measured with topramezone+atrazine (25.2+500 g/ha) EPoE *fb* IC + HW at 40DAS and the highest grain yield (6.88 t/ha) was also recorded for the same treatment. This treatment further reported the highest benefit cost ratio (2.25) as compared to the farmers practice (1.82).

The centre also conducted four OFR trials on weed management in lentil during *Rabi*, 2023-24. Predominant grassy weeds recorded under this situation where *Cynodon dactylon, Digitaria sanguinalis* and *Eleusine indica,* Predominant sedges were *Cyperus rotundus. Cyperus difformis. Physalis minima, Chenopodium album, Solanum xanthocarpum, Parthenium hysterophorus* and *Euphorbia hirta* were the broad-leaved weeds. The three treatments were;, T_1- pendimethalin 30EC 720 g/ha PE at 3 DAS *fb* imazethapyr10SL 30g/ha at 25 DAS, T_2- pendimethalin 30EC 1000 g/ha PE at 3 DAS *fb* quizalofop-ethyl 5EC 50g/ha at 25 DAS and T_3- Farmers' practice (Hand Weeding at 20 DAS). The results revealed

that T_2 recorded lowest weed dry weight in all type of weeds whereas farmers practice (T_3) recorded highest value. Further, T_2 recorded the highest seed yield (1.42 t/ha), highest stalk yield (2.44 t/ha), highest Net returns (Rs. 94185/ha) and Benefit cost ratio (3.58).

WP 4.2: Front Line Demonstrations

TNAU, Coimbatore

Five FLDs were carried out in onion at Pongalur block, Tiruppur, to demonstrate the herbicidal weed management practices to control early emerging weeds in onion. Two treatments were taken up: T1 - PE Oxyfluorfen 0.25 kg/ha + Hand weeding on 30-35 DAP and T2—Farmers Practice (2 Hand weeding). Total weed density and weed dry weight were lower with application of PE oxyfluorfen 0.25 kg/ha + Hand weeding on 30-35 DAP in all five locations compared to the farmer's practice. Among the treatments, higher bulb yield (10.72-13.56 t/ha) was recorded with PE Oxyfluorfen 0.25 kg/ha + Hand weeding on 30-35 DAP (T_1) which in turn increased the net returns. A higher percentage of yield increase (18.08 - 20.05) was recorded under the PE oxyfluorfen 0.25 kg/ha + Hand weeding on 30-35 DAP (T_1).

RVSKVV, Gwalior

Five FLDs were conducted on greengram in five farmer's fields in the village of Gobai, Bhawanpura, Ganpatpura and Dabka, District Gwalior during *summer* 2023 to demonstrate the benefit of the application of Imazethapyr + imazamox (RM) 50 g/ha as PoE. It was observed that, the application of Imazethapyr + imazamox (RM) 50 g/ha as PoE resulted higher grain yield over farmer's practice. The average yield in demonstrated plots was recorded 792 kg/ha which was 29.62% higher over farmer's practice. Similarly, higher BC ratio 3.21 was also recorded in the field where Imazethapyr + imazamox (RM) 50 g/ha as PoE was applied.

CSKHPKV, Palampur

Twenty demonstrations were conducted during 2022-23 in different crops. Demonstrations undertaken in the *Rabi* 2022-23 and *Kharif* 2023 seasons revealed 44.4% increase in grain yield of wheat, 12.7% increase in the peas pod yield, 31.3% grain yield of rice, 32.3% grain yield of maize, 36.4% in yield of soybean, 45.8% rhizome yield of turmeric and 41% in bulb yield of onions over the respective farmers' practice being undertaken in a particular crop.

PAU, Ludhiana

Seven FLDs were conducted in *Rabi* 2022-23. Pre-plant application of pyroxasulfone 127.5 g/ha in wheat sown with happy seeder under (ZT+R) provided similar weed control and grain yield to recommended post-emergence herbicides providing additional option of herbicide application at sowing in case of wheat sown with happy seeder. Six FLDs were conducted on weed management in maize during *Kharif* 2023. Uniform spreading of paddy straw mulch at 7.5 t/ha just after sowing of maize provided effective control of annual weeds (~93%) and provided 5.43 t/ha maize grain yield which was 13% higher than under farmer's practice (atrazine as pre- or tembotrione as post-emergence).

PJTSAU, Hyderabad

Five FLDs were conducted in rice during *Kharif* 2023 to popularize the integrated weed management technology in at Bijenepally, Tadur, and Kothakota Mandals in Nagarkurnool district, respectively, with the technology developed at AICRP-WM centre. The results from FLD's on rice during *Kharif*, 2023 showed that IWM involving post-emergence application of Triafamone 20% (44 g/ha) +ethoxysulfuron 10% WG (22.5 g/ha) at 225 g/ha as PoE *fb* hand weeding at 40 DAT resulted in efficient weed control in early crop growth stages compared to the farmers method. Further the manual labour requirement was less when the improved practice was adopted by the famer compared to the traditional method. This resulted in higher B:C in the range of 2.15 to 2. 58 compared to farmers method where in B:C of 2.01 to 2.44 was recorded. Further, the centre also conducted five FLDs in maize during *Kharif* 2023 to popularize the integrated weed management technology in at Mogilipalem village, Thimmapur Mandal in Karimnagar district. The results from FLDs showed that involving post-emergence application of Mesotrione 2.27% w/w + atrazine 22.7% w/w SC 875 g/ha at 3500ml/ha as PoE *fb* I/C at 40 DAS resulted in efficient weed control compared to the farmer's method and resulted in higher yields. Hence, higher B:C in the range of 1.37 to 2.49 was realized compared to farmers method where in B:C of 1.34 to 2.48 was recorded.

KAU, Thrissur

Six FLDs were conducted at different locations in farmers' fields to popularize the organic weed management technology- Green manuring (*in-situ*), transplanting of rice *fb* one hand weeding at 40 DAT. It was found from the demonstrations that the technology

provided efficient weed control and better grain yield as compared to farmers' practice- Direct seeding, two hand weeding at 25-45 DAT. The average grain yield obtained from the technology was 4.4 t/ha with a B:C of 2.03 whereas farmers' practice gave an average yield of 3.6 t/ha with a BC ratio of 1.71.

SKUAST, Jammu

Four FLDs on weed management in direct seeded rice were conducted in *Kharif* 2023 at farmers' fields in Jammu region under irrigated conditions. The weed management technology *viz.*, pendimethalin 1 kg/ha as PE *fb* triafamone + ethoxysulfuron 66.5 g/ha at 25 DAS was evaluated and compared with pendimethalin 1 kg/ha *fb* bispyribac-sodium 25 g/ha at 25 DAS as farmers' practice. The lower weed density, higher grain yield and B:C were recorded in technology treatment as compared to farmers' practice. The technology intervention showed a 9.96% higher mean yield as compared to the farmers' practice. Further, the center also carried out five FLDs in maize during *Kharif* 2023. Lower weed density, higher grain yield and B:C were recorded in technology treatment (topramezone + atrazine 25.2 + 500 g/ha at 15-20 DAS) as compared to farmer's practice (atrazine 1 kg/ha as PE). The technology intervention provided a 16.67 % higher mean yield as compared to farmers' practice.

RVSKVV, Raipur

Twenty-five demonstrations were conducted on weed management in direct seeded rice with treatment application of pre-emergence application of pyrazosulfuron 20 g/ha at 0-7 DAS *fb* bispyibac- Na g/ha at 20 DAS as technology transfer and other treatment i.e. farmers' practice was application use of bispyribac-Na 25g/ha at 20 DAS. The average yield of farmers' practice was 4.58 t/ha whereas the average grain yield obtained under improved technology treatments were 5.52 t/ha in However, the percent increase under recommended practice over farmers' practice was 18.75 %. The average benefit-cost ratio was appreciably higher (3.54) as compared to the farmers' practice (3.20).

AAU, Anand

Five FLDs were conducted in wheat during *Rabi* 2022-23 with application of sulfosulfuron 75%+ metsulfuron 5% WG (30+2 g/ha) at 30 DAS as technology transfer and metsulfuron 20% WP (4 g/ha) as farmers' practice at 30 DAS. The results of the demonstration revealed that the application of sulfosulfuron 75% + metsulfuron 5% WG (premix) 32 g/ha PoE recorded higher WCE and gave higher yield, net return and BC ratio (2.08) as compared to farmers practice metsulfuron 20% WP 4 g/ha (1.9). Further, the centre conducted five FLDs in *Rabi* maize in 2022-23. Atrazine 50% WP + topramezone 336 g/l w/v SC (TM) was the technology, and Farmers' practice was IC *fb* HW at 20 & 40 DAS. The demonstration results indicated that the technology treatment was found equally effective as farmers' practice. The centre also conducted five FLDs in summer groundnut with application of Fluazifop-p-butyl 11.1% w/w + fomesafen 11.1% (premix) 250 g/ha

fb IC+HW at 40 DAS as technology and IC *fb* HW at 20 and 40 DAS as farmers' practice. The results revealed that the technology demonstrated was equally effective as that of farmers' practice.

PDKV, Akola

Twenty FLDs were conducted on weed management in soybean with the Pre-emergence application of Diclosulam 84% WDG as improved technology and 1 Hoeing and 2 Hand weeding as farmers' practice. Farmers' practice recorded higher grain yield and gross monetary return over the pre-emergence application of diclosulam. However, the benefit-cost ratio was on par with the technology demonstrated since the cost of cultivation of farmers' practice is much higher than improved technology.

GBPUAT, Pantnagar

Ten front-line demonstrations were conducted at farmer's fields during the *Rabi* season of 2022-23 in Distt. U.S. Nagar, Uttarakhand. The experiment comprised carfentrazone + sulfosulfuron (20+25 g/ha) applied at 30 DAS under improved technology, whereas sulfosulfuron + MSM (30+2) g/ha ready mix applied at 30 DAS was taken under farmers' practice. These two treatments were compared with a weedy check for yield loss estimation. The higher grain yield, 4.5 t/ha, net return of Rs. 60034.0/ha, and B:C of 2.42 were recorded with improved technology. The center also conducted seven FLDs at farmers' fields in Distt. U.S. Nagar, Uttarakhand. The trial comprised of cyhalofop butyl + penoxsulam 135g/ha at 25 DAS applied as improved technology, whereas pretilachlor 50 % EC 750 g/ha (PE) was applied as farmers' practice within 3 days of transplanting. These two treatments were compared with weedy check for yield loss estimation. The highest grain yield of 4.4 t/ha, net return Rs. 64698.0/ha, and B:C of 2.43 were recorded with improved technology over the farmers' practice.

Two FLDs on maize were conducted during *Kharif* season of 2023 in Distt. Nainital. Topramezone 25.2 g/ha (PoE) was applied as improved technology and atrazine 500 g/ha (PE) was taken as farmer's technology to compare the better efficacy of herbicides on weeds and yield of maize. The highest weed control efficiency of (74.3 %), grain yield (16.0 t/ha), net return (Rs. 88466.0/ha) and BC ratio (3.40) was recorded with improved technology and the increase in yield was 36.4% higher than farmers' practice. Further, the centre conducted three FLDs in sugarcane during *Spring* season of 2023 in Distt. Udham Singh Nagar. The treatments were comprised of ametryne 80 WDG 2.0 kg/ha PE as recommended technology, whereas tembotrione 120 g/ha was taken as the farmer's practice. *The* highest grain yield (98.80 t/ha), net return (Rs. 253360/ha), and B:C (3.90) were reported in the case of improved technology, and the yield increase was 9.1% over farmers' practice.

OUAT, Bhubaneswar

Ten FLDs on weed management in transplanted rice were conducted during *Kharif* 2023. Application of bispyribac sodium (0.025 kg/ha) taken as improved technology and hand weeding at 25 and 40 DAT as farmers' practice. The highest yield was obtained in the plot's technology applied (4.2 t/ha), and it was a 42% increase over the farmers' practice and the B:C of the technology demonstrated was 2.97, whereas it was 1.84 in farmers' practices.

Table 4.2.1 Extension Activities undertaken by coordinating centres

	Centre Name	Training imparted	Radio talks	TV Programmes	Kisan Mela/ Kisan Day	Handout/ folders/pamphlets	Bulletins/ booklet	Training participated	On farms trial	Frontline demonstrations	Parthenium awareness
1	PAU, Ludhiana	1	0	0	1	0	2	3	10	13	
2	UAS, Bengaluru	6	0	2	2	0	0	1	17	0	√
3	RVSKVV, Gwalior	0	0	0	2	0	2	0	2	5	√
4	GBPUAT, Pantnagar	1	4	0	0	0	0	5	14	24	√
5	CSKHPKV, Palampur	0	1	0	0	0	3	0	14	222	√
6	AAU, Jorhat	7	1	0	0	0	0	2	0	0	–
7	AAU, Anand	6	0	1	0	0	0	3	2	15	√
8	TNAU, Coimbatore	4	0	0	0	5	1	8	5	5	√
9	KAU, Thrissur	0	1	0	0	0	0	3	4	6	
10	OUAT, Bhubaneshwar	0	1	2	0	0	3	0	8	2	√
11	PJTSAU, Hyderabad	0	3	1	0	0	0	8	1	5	√
12	CCSHAU, Hisar	2	3	0	0	0	0	3	0	5	√
13	IGKV, Raipur	4	3	0	0	1	1	0	25	25	√
14	PDKV, Akola	0	3	0	0	4	0	6	6	1	√
15	BCKV, Kalyani	0	0	0	0	0	0	3	4	0	√
16	MPUAT, Udaipur	4	0	0	0	0	0	1	6	88	
17	SKUAST, Jammu	0	0	0	0	0	0	3	2	64	√
	Total	**35**	**20**	**6**	**5**	**10**	**12**	**49**	**120**	**480**	**13**

WP 4.3. Impact assessment of weed management technologies

AAU, Anand

The seven technologies developed during the last five years on weed management are demonstrated in the farmers' field, and awareness during training programmes on weed management has a positive impact on the adoption of weed management technologies in different crops. Farmers survey conducted in Anand district revealed that the weed management technology clodinafop-propargyl 15% + metsulfuron-methyl 1% WP in wheat had covered 18000 ha in Anand district and which has provided a yield increase of .36 t/ha and an average cost saving of Rs. 4882 per ha. Similarly, propaquizafop 2.5% + imazethapyr 3.75% w/w ME in soybean crop have been adopted by 20% of farmers in the Dahod district and which had given a yield increment of 0.26 t/ha and cost saving of Rs. 10, 980 per ha. Early post-emergence (10-15 DAS) application of imazethapyr 100 g/ha *fb* IC + HW at 40 DAS in summer groundnut has been adopted by 25% of farmers in Chotaudepur district with an area coverage of 600 ha. In the same district, pendimethalin 900 g/ha *fb* IC+HW at 30 and 60 DAS in cotton has been adopted by 35% of farmers with an area coverage of 30000 ha.

OUAT, Bhubaneswar

A study on 'Impact analysis on weed management' was carried out in coastal districts by surveying 250 farmers. One additional application of post-emergence herbicide bispyribac Na 0.02 kg/ha 25 DAS provided a 13-18% increase in yield with an average cost savings of Rs. 2500 per ha. The approximate area covered by the technology in the district was 16650 ha, and around 9% of farmers adopted the technology to control the weeds in rice. The cost of the product and the ineffectiveness of the herbicide against perennial weeds were the major constraints that hindered the adoption. Another one survey conducted in western district among 200 farmers revealed that Application of (RM) Bensulfuron methyl+pretilachlor 0.66 kg/ha as pre-emergence (0-2 DAT) in rice resulted a yield increase of 18-20% with an average cost savings of Rs.3000 per ha. The approximate area coverage of this technology in these districts was 8650 ha and around 32% of farmers adopted the technology.

KAU, Thrissur

A study was conducted to assess the impact of weed management technologies adopted by farmers of Kerala. For the study, information was collected from the farmers of Thrissur and Palakkad districts using a pre-tested questionnaire. The study aimed to observe the changes in farmers' living standards and livelihood security after adopting weed management technologies. Among the respondents, 52.77% of the farmers were marginal farmers with less than 1 ha of land; 25% of the farmers were small farmers, 13.88% were medium farmers, and 8.33% were large farmers. Most of the respondent farmers (56%) practiced direct-seeded rice cultivation, and 44.44% adopted transplanting. The adoption of weed management technologies resulted rice yield increased by 300 kg/acre in the *Kharif* season and 200 kg/acre in *Rabi*. The effect was seen in the net income too, which increased by 13,400 Rs/acre in the *Kharif* season and 10,600 Rs./acre in *Rabi*. Farmers gained access to weed management technologies primarily through training and newspaper articles. 80.55% of the farmer respondents were accessing these sources. Exhibitions are another type of source that 61.11% of farmers use. 50% of the farmers depend on the radio and TV for information. Lack of equipment availability was the major constraint faced by the farmer respondents (70%) when adopting herbicide technology. About 52% of the farmers are constrained by high labour costs for herbicide application.

TNAU, Coimbatore

The impact of weed management technology *viz*., PE Pendimethalin 1 kg/ha *fb* hand weeding 30-35 DAP was studied in groundnut under irrigated and rainfed conditions. A farmers' survey was carried out in the Coimbatore district in the villages *viz*., Puravipalayam and Zamin Kalathur (rainfed), Kanuvakarai, and Ambothi (irrigated). A total number of 110 farmers were surveyed. Weeds are the major problem in groundnuts in both under-irrigated and rainfed conditions. Farmers practice two-hand weeding under irrigated conditions at 20 and 40 DAS and one HW

at 40 -45 DAS under rainfed conditions. The study revealed that 70 % of farmers surveyed under irrigated and 51% of farmers surveyed under rainfed conditions followed the application of Pendimethalin 1 kg/ha at 3 DAS for the control of weeds. Further, the average yield increase in irrigated conditions was 0.4 t/ha, and that of rainfed was 0.32 t/ha. Farmers expressed that the application of herbicide is feasible under irrigated conditions, whereas under rainfed conditions, the application of herbicide was made based on rainfall and the availability of moisture.

AAU, Jorhat

An Impact assessment study was conducted in three districts, *viz.*, Jorhat, Kamrup Metro, and Kamrup Rural, covering altogether 120 rice-growing farmers and agriculture Input dealers. From the study, it was observed that 15.4 % and 36.17% of farmers are using pretilachlor 50 EC 0.75 kg/ha at 3 DAT in about 13,100 and 33,000 ha transplanted *Kharif* rice of Jorhat and Kamrup (Metro & rural) districts, respectively. The corresponding values for pyrazosulfuron ethyl 10% WP 0.25 kg/ha at 3 DAT *fb* post-emergence application of 2,4-D 0.5 kg/ha or bispyribac-sodium 10% SC 0.25kg/ha are 42.30% and 11.70% which covers 36,200 and 10,000 ha. On the other hand, the rotary paddy weeder between 20 to 40 DAT is adopted by 7.70 % and 4.13% of farmers covering an area of 6,500 and 7,800 ha, respectively, in these districts.

MPUAT, Udaipur

The centre has surveyed seven districts: Udaipur, Rajsamand, Dungarpur, Banswara, Chittorgarh, Pratapgarh, and Bhilwara, to assess the impact of nine weed management technologies developed by the centre. The important results of the study indicated that the technology "post-emergence application of either imazethapyr 75 g/ha + propaquizafop 75 g/ha (TM) at 21 DAS or imazethapyr 75 g/ha + quizalofop ethyl 60 g/ha (TM) at 21 DAS in soybean resulted a yield increase of 21% and about 25-30% of farmers in the district adopted the technology. Similarly, the application of oxadiargyl at 100 g/ha as pre-emergence, followed by one-hand weeding at 40 DAS, gave a yield increase of 23%, and about 15-25% of the farmers adopted the technology. In greengram, the technology "acifluorfen 16.5%+ clodinofop 8% EC (RM) at 245 g/ha as post emergence 21 DAS at 3-4 leaf stage" was adopted around 5-10% of the farmers and the yield increase was about 22%.

4 RECOMMENDATION FOR PACKAGE OF PRACTICES

AAU,Anand

- Application of pendimethalin 30 EC 500 and 750 g/ha at 10 DAS and pendimethalin 30+imazethapyr 2 EC 640 & 800 g/ha at 10 DAS were found effective for *Cuscuta* management in lucerne with higher green fodder production.
- Application of pendimethalin 30 EC 500 g/ha + oxyfluorfen 23.5% EC 120 g/ha PE (TM) *fb* HW at 40 DAS, topramezone 336 g/l w/v SC 15 g/ha PoE *fb* HW at 40 DAS and topramezone 336 g/l w/v SC 15 g/ha EPoE *fb* HW at 30 DAS were found effective for weed management in chickpea with higher net return and B: C.
- Application of pendimethalin 30+ imazethapyr 2 EC (premix) 800 g/ha *fb* IC + HW at 40 DAS, pendimethalin 30 EC 750 g/ha *fb* Intercultural (IC) + HW at 40 DAS, diclosulam 84WDG + pendimethalin 30EC (tank mix) 25.2+500 g/ha *fb* IC + HW at 40 DAS, propaquizafop 2.5 + imazethapyr 3.75 w/w ME (premix) 125 g/ha *fb* IC + HW at 40 DAS were found effective for weed management in *Kharif* groundnut with higher B:C
- Application of quizalofop ethyl 7.5 + imazethapyr 15 w/w EC 112.5 g/ha PoE, propaquizafop 2.5+ imazethapyr 3.75 w/w ME 125 g/ha PoE, IC *fb* HW at 15 & 30 DAS and imazethapyr 35 + imazamox 35 WG 70 g/ha PoE were found effective for weed management and higher net return in *Kharif* blackgram.
- Application of propaquizafop 5 + oxyfluorfen 12 w/w EC (PM) 43.75+105 g/ha EPoE, pendimethalin 30 EC 300 g/ha PE and twice hand weeding carried out at 15 and 30 DAS were found effective for the management of complex weed flora with higher net return in onion nursery.
- Application of pendimethalin 38.7 CS 580.5 g/ha PPI *fb* oxyfluorfen 23.5EC 120 g/ha PoE, hand weeding at 20 and 40 DAT, propaquizafop 5+ oxyfluorfen 12 w/w EC (PM) 43.75 +105 g/ha PoE and oxyfluorfen 23.5 EC 120 g/ha PE *fb* propaquizafop 5 + oxyfluorfen 12 w/w EC (PM) 43.75 +105 g/ha PoE found effective for weed management with higher net return and B:C in transplanted onion crop.
- In direct-seededrice, application of triafamone 20 + ethoxysulfuron 10 WG (44.0+22.5 g/ha) EPoE (PM) *fb* HW at 30 DAS, penoxsulam 1.02 + cyhalofop-butyl 5.1 OD 120 g/ha EPoE (PM) *fb* HW at 30 DAS, bispyribac-sodium 20 + pyrazosulfuron-ethyl 15WDG 35 g/ha EPoE (premix) *fb* HW at 30 DAS, pretilachlor 30 + pyrazosulfuron-ethyl 0.75 WG 600+15 g/ha PE (premix) *fb* HW at 30 DAS and mechanical weeding carried out at 20 and 40 DAS found effective for weed management with higher net return and B:C under irrigated condition of Gujarat.
- Application of propaquizafop 2.5 + imazethapyr 3.75 w/w ME (premix) 125 g/ha EPoE followed by IC + HW at 40 DAS and quizalofop ethyl 7.5 + imazethapyr 15 w/w EC 112.5 (premix) EPoE *fb* IC + HW at 40 DAS produced 10.5 and 8.77 higher yield, net return and B:C as compared farmers practice (IC + HW at 20 and 40 DAS) in soybean.
- Atrazine 50 WP + topramezone 336 g/l w/v SC (TM) 500+25.2 g/ha PoE (15-20 DAS) found as effective as farmers practice (IC+HW at 20 and 40 DAS) in Rabi maize.
- Sulfosulfuron 75 + metsulfuron 5 WG (premix) 30+2 g/ha PoE (25-30 DAS) found effective for the management of complex weed flora in wheat compared to metsulfuron 20 WP alone.
- Fluazifop-p-butyl 11.1 w/w + fomesafen 11.1 (premix) 250 g/ha EPoE (10-15 DAS) *fb* IC+HW at 40 DAS found as effective as farmers practice (IC+HW at 20 and 40 DAS) in summer groundnut.

CSKHPKV, Palampur

- Pendimethalin 1000 g/ha *fb* bispyribac 25 g/ha +

metsulfuron methyl + chlorimuron ehyl 4 g/ha (25-30 DAS), penoxulam + pendimethalin 625 g/ha *fb* bispyribac sodium 25 g/ha 25-30 DAS, penoxulam + pendimethalin 625 g/ha *fb* fenoxaprop ethyl 67 g/ha + ethoxysulfuron 18 g/ha 25-30 DAS, pendimethalin 1000 g/ha *fb* penoxulam + cyhalofop butyl 135 g/ha and pretilachlor 600 g/ha *fb* penoxulam + cyhalofop butyl 135 g/ha were the effective weed management treatments in direct-seeded rice.

- Fluazifop-p-butyl + fomesafen (RM) followed by pendimethalin + imazethapyr (RM) and sodium acifluorfen + clodinafop propargyl were the effective weed management treatments in soybean.
- Oxyfluorfen 150 g/ha + handweeding was most effective weed management treatment in rajmash.
- Pre-emergence application of imazethapyr 75 g/ha and post-emergent propaquizafop 50 g/ha was promising herbicidal treatment for weed control in peas in dry temperate region.
- Pendimethalin 1 kg/ha as PE *fb* quizalofop-p-ethyl 50 g/ha at 30 DAS, pendimethalin 1 kg/ha as PE *fb* Imazethapyr 75 g/ha at 30 DAS, and pendimethalin 1.0 kg/ha + imazethapyr 75 g/ha (PE) were the most effective weed management schedules in controlling weeds in blackgram.
- Imazethapyr 75g/ha + hand weeding was most effective weed management treatment in garden peas under mid hill conditions of Himachal Pradesh.
- Pretilachlor 500 g/ha + imazethapyr 50 g/ha (pre-emergence) *fb* HW was most effective integrated weed management option in Frenchbean.

GBPUAT, Pantnagar

- Application of pre-emergence herbicide atrazine 50WP 0.5- 1.0 kg /ha, post-emergence- 2,4 –D dimethyl amine salt 58 SL 0.5 kg /ha or 2,4-D ethyl ester 38 EC 0.9kg/ha or 2,4-D sodium salt 80WP 1.0 kg/ha, halosulfuron methyl 70WG 67.5 g/ha, tembotrione 34.4 SC 120 g/ha (poe) or topramezone 33.6SC 25.2-33.6 g/ha+ adjuvant 2 ml/l of water(PoE) and IWM- atrazine 50WP at 1000 g/ha PE *fb* one HW at 35 DAS were more effective in maize.
- In direct-seeded rice, pre-sowing irrigation at 20-25 days before sowing (stale seed bed technique). Use wet bed method for wet seeding of direct seeded rice. Apply seed rate of 40 kg/ha for course rice and 25-30 kg/ha for fine rice. Maintain row and plant spacing at 20 cmX10 cm for optimum plant stand may compete with initial growth of weeds. Chemical-cendimethalin 30EC 1.0 - 1.5kg/ha post grassy-cyhalofop-butyl 10% EC at 75-80 g/ha BLWs-metsulfuron methyl 4.0 g/ha at 25-30 DAS grassy and non-grassy-penoxsulam 24% SC 22.5-25.0 g/ha (early PoE) or bispyribac-Na 20g/ha.
- In rice-wheat conservation system, transplanted rice (TPR)-zero tillage wheat (ZTW) along with green manuring of *susbaina* and an application of bispyribac-Na 20g/ha at 20DAT(PoE) *fb*1HW at 45DAT in rice and ready-mix application of clodinafop+metsulfuron methyl 60+4 g/ha (PoE) supplementation of 1 HW at 45 DAS in wheat, is recommended.
- In organic mode of weed management in rice-wheat cropping system, stale seed bed *fb* direct seeded riec in furrows and soybean in raised bed *fb* one hoeing and one HW and in wheat in raised bed and mentha in furrows *fb* one HW is recommended.
- Under Agri-Horti cropping system (Integrated farming system) highest seed yield of black gram was obtained with imazethapyr 10% SL (100g/ha), whereas, in maize highest grain yield was achieved with topramezone (25 g/ha) *fb* 1HW.

IGKVV, Raipur

- Motorized weeder twice (single row type) in rice and black polythene (25µ) mulch in sweet corn generated the highest system yield and net return from organic scented rice – sweet corn cropping system.
- Pendimethalin 1000 g/ha (30EC) as PE *fb*

bispyribac sodium 25 g/ha + (metsulfuron methyl + chlorimuron ethyl) (RM) 4 g/ha tank mix PoE (25-30 DAS) found very effective to control the weed density in direct seeded rice and produced highest grain yield and net return.

- Atrazine 500 g/ha as PE *fb* 2, 4-D sodium salt 800 g/ha as PoE found to be most effective to reduced the kharif weeds in direct-seeded finger millet, achieved highest WCE and highest grain yield (1.75 t/ha), net return and B:C. Atrazine 500 g/ha as PE *fb* metsulfuron-methyl + chlorimuron-ethyl 4 g/ha PoE has also found to be comparable in terms of producing grain yield and net return.

MPUAT, Udaipur

- Application of pre-emergence spray of oxadiargyl 6 EC at 75 g/ha followed by post-emergence quizalofop-ethyl 5EC at 40 g/ha for effective weed control in dill crop.
- Application of oxadiargyl 50 g/ha PoE (25 DAS) fb HW at 50 DAS gave maximum seed yield with minimum weed density in Isabgol.
- Post–emergence application of carfentrazone-ethyl + sulfosulfuron (Premix) at 45 g /ha at 35 DAS in wheat.
- Application of imazethapyr 10+ propaquizafop 10 (Tank Mix) 60+75 g/ha *fb* IC + Hand Weeding at 40 days after sowing for weed management in groundnut.

PAU, Ludhiana

- **PAU Surface Seeder**: It consists of seed & fertilizer box attachment, with fluted roller metering system, mounted on to a cutter-cum-spreader. It is a simple and low-cost machine which does uniform broadcast of wheat seed & basal fertilizer along with cutting & spreading of paddy straw in a single operation. It is followed by irrigation for initiating the germination of wheat seeds. This machine can be easily operated by the 40 HP tractor or above. The wheat sown through surface seeding method have lower weed infestation especially *Phalaris minor* than other wheat seeding methods.

  Collaboration: Deptt of Farm Machinery & Power Engg

- **Pre-emergence weed management in wheat**: Pre-emergence application of ready mixture of pendimethalin 40 + metribuzin 8 1080 g/ha provides effective control of *Phalaris minor* and some broadleaf weeds in wheat.

SKUAST, Jammu

- Paddy straw mulch (6 t/ha) + 1 hand weeding at 30 DAT found suitable for weed control in broccoli under organic farming.
- Clodinafop-propargyl + metsulfuron (60 + 4 g/ha) and sulfosulfuron + carfentrazone 25+20 g/ha at 30 DAS was found most suitable for weed management in zero- till wheat.

TNAU, Coimbatore

- In transplanted rice-rice cropping system application of PE pyrazosulfuron ethyl 10 WP 150 g/ha on 3 DAT + hand weeding (HW) on 45 DAT.
- Conventional tillage (disc ploughing + two harrowing) with PE application of atrazine 0.5 kg /ha for maize and pendimethalin 1.0 kg/ha for sunflower + hand weeding on 45 DAS in maize – sunflower cropping System.
- Post emergence application of pyrithiobac-sodium 62.5 g/ha + quizalofop-ethyl 50 g/ha at 2 to 4 leaf stage or 45 DAS for Integrated weed management in cotton.
- Pre-emergence application of pendimethalin 0.75 kg on 3 DAS followed by early post-emergence application of imazethapyr 60 g/ha on 15 DAE of weeds (2 - 3 leaves stage of weeds) and quizalofop ethyl 50 g/ha on 20 DAE of weeds (2-3 leaves of weeds) are recommended for controlling broad leaved and grassy weeds in black gram and green gram respectively.
- Application of glyphosate 15 g and ammonium sulphate 20 g and 2ml soap solution or glyphosate 10 g and 2,4 D sodium salt 8 g per litre of water on rosette stage of parthenium for its control.

BCKV,Kalyani

- Rice transplanted pretilachlor 750 g/ha as pre-emergence *fb* bispyribac-Na 25 g/ha as post-emergence at 25 DAT.

- Cabbage: oxyfluorfen 150 g/ha pre-plant incorporation *fb* quizalofop 50 g/ha at 30 DAT.
- Cowpea (vegetable) pendimethalin 0.75 kg/ha at 0-3 DAS *fb* quizalofop ethyl 50 g/ha at 20 DAS.
- Maize: topramezone + atrazine (25.2+500 g/ha) EPoE *fb* IC + HW at 40 DAS.
- Olitorius Jute: use of nail weeder- 1st at 5-6 DAE and 2nd at 15 DAE + one hand weeding (within the row) at 25 DAE can be a very good option.
- Sugarcane: Lowest weed pressure, higher yield attributes and yield of sugarcane and benefit-cost ratio is possible with application of atrazine 2.0kg/ha *fb* metsulfuron + carfentrazone (RM) 25g/ha PE *fb* PoE-60 DAP

OUAT, Bhubaneswar

- Application of pendimethalin 30 EC 0.75 kg /ha as PE *fb* straw mulch 5t/ha was found to be most effective in controlling the complex weed flora with highest net return in *Rabi* mustard.

PDKV, Akola

- Post emergence application of imazethapyr + imazamox 0.070 kg/ha PoE 15 DAS was the most remunerative and effective herbicide for controlling the weed flora and getting higher yield and economic returns in soybean.
- In cotton pre-emergence application of pendimethalin1.00 kg/ha followed by directed spray (by using protective shield) of non-selective herbicide paraquat 0.60 kg/ha at 45 days after sowing is recommended for controlling weeds with higher yield and monetary returns.
- In maize, pre-emergence application of atrazine 0.50 kg/ha followed by post emergence application of tembotrione 0.120 kg/ha at 20 DAS were the most remunerative and effective herbicides for controlling the weed flora and getting higher yield and economic returns.
- post-emergence application of imazethapyr+ imazomox 0.07 kg/ha 20 DAS was the most remunerative and effective herbicide for controlling the weed flora and getting higher yield and economic returns in groundnut.
- In turmeric, pre-emergence application of pendimethalin 1 kg/ha or metribuzin 0.7 kg/ha or atrazine 0.75 kg/ha (0-5 DAP) *fb* straw mulch 10 t/ha (10 DAP) *fb* one HW (75 DAP) is recommended for controlling weeds with higher yield and monetary returns.
- It is recommended that the post-emergence application of clodinafop propargyl+ metsulfuron methyl 0.06 + 0.004 kg/ha or sulfosulfuron + metsulfuron methyl 0.03 + 0.002 kg/ha at 35 DAS were the most remunerative and effective herbicides for controlling the weed flora and getting higher yield and economic returns in wheat.
- In soybean post-emergence application of propaquizafop 0.050 kg+imazethapyr 0.075 kg/ha at 21 DAS or pre-emergence application of diclosulam 84 WDG 0.026 kg/ ha is recommended for higher seed yield and economic returns.
- In Maize, for effective weed management and higher net returns it is recommended to apply pre-emergence herbicide atrazine 50 WP 0.50 kg/ha (1 kg/ha commercial product) *fb* post-emergence application of topramezone 33.6 SC 0.0252 kg/ha (75 ml/ha commercial product) at 25 DAS.

PJTSAU, Hyderabad

- Growing soybean as intercrop in cotton at 1:2 in alfisols was found to suppress the weed growth evident from reduced weed density and weed dry weight compared to sole crop and other intercrops i.e., sesamum and Sesbania (live mulching up to 40 DAS) and gave 7.0 % additional cotton equivalent yield (1769 kg/ha) over sole cotton (1653 kg/ha).
- Under intercropping, application of pendi-methalin (38.7 CS) 640 g/ha as PE *fb* hand weeding at 30 and 45 DAS (IWM) was found to be effective for weed control and resulted in higher cotton equivalent yield (1762 kg/ha) over chemical weed control i.e., pendimethalin (38.7 CS) 640 g/ha as PE *fb* quizalofop- ethyl 45 g/ha as PoE at 25 DAS (1397 kg/ha).

5 SCHEDULED CASTE SUB-PLAN PROGRAMME

CSKHPKV, Palampur

Under SCSP scheme, various trainings / demonstrations on Weed Management in vegetables, cereals, summer and *Kharif* crops, cropped and non-cropped land, wheat and pasture lands etc. were conducted in 7 villages *viz.* Gadyara (Khaira), Kharul, Kamlehar, Sornu, Ramehar, Rajehar (Kandwari), Drekari (Salooni Chamba) for SC farmers. These trainings were attended by 222 SC farmers of villages and they were also distributed with sprayers, vegetables seeds, weeding tools, herbicides, garden spade, etc.

KAU, Thrissur

Under SCSP scheme, different agricultural inputs such as weed cutter, sprayers and herbicides were provided to the 21 scheduled caste farmers of the region. In addition to this, 2 Front Line Demonstrations at 10 places were also conducted under the scheme. The use of premix herbicides penoxsulam+ butachlor and penoxsulam + pretilachlor for broad spectrum weed control in rice was the technology demonstrated under the scheme. Use of other post-emergent and pre-emergent broad spectrum herbicides were also demonstrated.

RVSKVV, Gwalior

Under the scheme, agricultural inputs such as seed (greengram), fertilizers (*Rhizobium* & DAP) and herbicides (imazathapyr + imazamox) for one acre area were distributed among 22 farmers and 9 spray pumps with battery were distributed among 9 farmers of different villages. Two Krishak sangoshthi was also organized at village Ganpatpura, Gwalior district and Village Kumheri, Morena with the help of KVK, Morena to introduce the SCSP programme in the locality with the aim to upgrade the socio-economic condition of the farmers.

TNAU, Coimbatore

Under SCSP, centre provided different weed management technologies for agricultural and horticultural crops and inputs like herbicides, small tools and technological knowhow through leaflets and pamphlets to the farmers. In addition to this, one training programme on "Integrated Weed Management in maize" was conducted during Dec, 2023 at Vagarai village of Palani taluk of Dindigul district. Total 25 scheduled caste farmers attended and benefited through the training programmeon Integrated Weed Management in maize. They were given inputs *viz.*, herbicide, farm tools, and training kit consisting of leaflets and pamphlets about the weed management technologies. Herbicide application techniques were also demonstrated to the farmers at cropped and non-cropped areas.

MPUAT, Udaipur

Scheduled Caste Sub Plan (SCSP) activities were undertaken during *Kharif*, 2023-24 at selected locations in which demonstrations, trainings, and human resources development activities were carried out. 53 demonstrations were conducted on maize, blackgram and soybean crops under SCSP programme and farmers were trained on the use of improved varieties, improved production technology especially weed management technology, promotion of small agricultural tools/techniques, use and application of herbicides in different crops.

SKUAST, Jammu

Under SCSP, 5 FLDs in *Kharif* season on "Weed management in transplanted rice" were conducted during the period. In these demonstrations, effect of herbicide triafamone + ethoxysulfuron 66.5 g/ha at 25 DAT was shown to the SC farmers compared to farmer's practice (bispyribac-sodium 25g/haat 25 DAT). During *Rabi* season, 50 FLDs were conducted on "Weed management in wheat" where effect of herbicide clodinafop-propargyl+metsulfuron (60 +4 g/ha) at 30-35 DAS was shown to the SC farmers compared to farmers' practice (metribuzin 200 g/ha at 30-35 DAS).

In all front-line demonstrations on weed management in transplanted rice, the lower weed density, higher grain yield and B: C were recorded in test treatment (triafamone + ethoxysulfuron 66.5 g/ha at 25 DAT) as compared to farmer's practice (bispyribac-sodium 25g/ha at 25 DAT). The new herbicidal intervention *i.e.* triafamone + ethoxysulfuron 66.5 g/ha at 25 DAT recorded 11.01% higher mean yield as compared to farmer's practice (bispyribac-sodium 25g /ha at 25 DAT).

In all the 50 Front line demonstrations, the lower weed density, higher grain yield and B:C was recorded in clodinafop-propargyl+metsulfuron (60+4 g/ha) at 30-35 DAS as compared to farmers practice *i.e.* metribuzin 200 g/ha at 30-35 DAS at all the locations.

Activities of under SCSP at SKUAST, Jammu

Under SCSP Programme, Knapsack sprayers were also distributed to SC Farmers at Ismailpur Kothey, Bishnah, Jammu during August, 2023.

Under SCSP Programme, Knapsack sprayers were also distributed to SC Farmers at Ismailpur Kothey, Bishnah, Jammu during August, 2023.

CCSHAU, Hisar

Under the scheme, two days training programme on Spray Technique in Field Crops was conducted along with the input distribution programme at Department of Agronomy, CCS HAU, Hisar during 21-22 March, 2023. Inputs such as herbicides, nursery trays, grow bags, spade, Khurpa and mineral mixture were also provided to SCSP farmers. One day training programme on weed management in Rabi crops at Regional Research Station was conducted for SC farmers on 21 Dec, 2023.

GBPUAT, Pantnagar

Under SCSP programme, centre conducted Front line Demonstrations on wheat,transplanted rice, soybean, maize and sugarcane during *Rabi*, 2022-23 and *Kharif*, 2023. Centre also organized one day training programme on "Weed management in *Rabi* crop" on January 10, 2024, in the village Jaipur bisa, Nanital district. The farmers were informed about new weed management technologies developed at Pantnagar by the scientists. Leaflets of the technologies developed were also distributed among the farmers. The issues related to weed management and general agronomical aspects of the crops during *Rabi* season were discussed and respective solutions were suggested to the farmers.

PAU, Ludhiana

Twenty SC farmers form district Faridkot were selected under SCSP programme. The farmers were provided hands-on-training on improved cultivation practices, weed identification, weed management and improved spray technology in wheat. The selected farmers were provided with critical inputs such as herbicide, pesticide and fungicide for effective and timely management of weeds, insect and diseases in wheat crop. The project personnel regularly monitored the crops of selected farmers.

UAS, Bengaluru

Under SCSP, farmers were made aware about the various method of weed management and its integration to reduce the human dependency on manual hand weeding and also farmers were educated about the use of herbicides more effectively for different crops. Weed management tools / equipments were distributed to the people of Avani village, Devarayanasamudra, Mulbagal taluk, Kolar District on 9th November 2023. Under the scheme, Hand weeders-12, Bullock drawn seed drill-4 and local hand weeding tools like Kol Guddali - 4and Varari-40 were distributed to the needy SC farmers.

OUAT, Bhubaneswar

Under SCSP scheme, 1 SC dominated village *viz.* Chennua, Nimapada, Puri was selected with 30 farm families to carry out different activities under the scheme. Farm implements for weed management *viz.* sickle (falcon), spade (TATA), hoe (Khurpi) and herbicide pendimethalin were distributed to the SC farmers. Centre also conducted awareness training programmes for the SC farmers.

6 LINKAGES AND COLLABORATION

Centre	Linkages and collaboration	Nature of linkages and collaboration
AAU, Jorhat	• Govt. of Assam • State Veterinary Department, Sivasagar, Assam • IRRI-South Asian Research Centre, Varanasi	• Member, Study Committee for the possible sources of heavy metals in soil, water, fruits and vegetables • Parthenium control in the State Veterinary Dispensary, Borahibari campus, Sivasagar • Associated with different adhoc projects since 2018
CCSHAU, Hisar	• IRRI, CIMMYT and many multinational companies. • State Department of Agriculture, Haryana.	• All the recommendations in pipe line are tested at farmers' fields by extension officers of KVK's and Department of Agriculture, Haryana
CSKHPKV, Palampur	• AICRP-IFS	• Weed dynamics and phytosociological studies in diversified cropping systems
GBPUAT, Pantnagar	• State Agriculture Universities • Anglo American India Pvt. Ltd.	• Advice on weed management • Research on weed management in different crop and cropping system
IGKVV, Raipur	• AICRP- IFS and NPOF • 20 Krishi Vigyan kendra's • Department of Agriculture, Government of Chhattisgarh • International Cricket Stadium, Raipur • Drone technology to students of Matts University, Raipur	• For Weed control advisory • Invited as technical expert to extend the Drone technology for weed control with herbicide with demonstration
KAU, Thrissur	• Krishi Vigyan Kendras in various districts • State Seed Farm, Mannuthy State Seed Farm • Agricultural Research Station, Mannuthy, Rice Research Station, Vyttila, Cashew Research Station, Madakkathara, FSRS Sadanathapuram& Regional Agricultural Research Stations of KAU • Pesticide residue lab • Kerala Forest Research Institute, Peechi • Kerala State Biodiversity Board • Government Engineering College, Thrissur • Synthite Industries Pvt. Ltd Kerala	• Transfer of technology / Trainings, Farmers "field trials and FLDs", Beneficiary selection for SCSP • Field trials/ Observational trials • Station trials, Transfer of technology and network trials • Herbicide residue studies • Alien Weeds, algal taxonomy, advanced analytical facilities • Awareness programme • A mini project on the development of laser-based robotic weed control • Integrated weed management in japonica rice cultivation at Ernakulam District, Krishi Bhavan, Aikkaranad panchayath as part of CSR programme of the Company (2023-24)
MPUAT, Udaipur	• AICRPs & AINPOF • Private industries	• Organic weed management in sweet corn-Fennel cropping system. • Scientist of AICRP on IFS are associated for conducting Benchmark Survey, FLDs and OFR.

Table contd. ...

MPUAT, Udaipur	• AICRPs & AINPOF • Private industries	• Syngenta India Ltd. Evaluation of Epivio Energy (product of natural origin) for use in Soybean as seed treatment for supporting plant growth & Yield Enhancement • Gharda Chemicals Pvt. Ltd., Dombivali, Dist Thane, (Mh) A New Herbicide molecule evaluation on cotton. • M/s ISK Biosciences India Pvt. Ltd, New Delhi Bio-efficacy of SL-950 6% OD in Maize crop against weeds and its effect on succeeding crop during upcoming Kharif (5.0 lakh) • I.S.K. Biosciences India Pvt. Ltd., New Delhi. A New Herbicide molecule evaluation on maize. • BAYER Crop Science Limited, Thane, Maharashtra, A New Herbicide molecule evaluation on wheat • UPL Pvt. Ltd. Mumbai: Discussion, Field visit and Research on New molecule evaluation on cotton, Soybean, sugarcane and funding source. • Gharda Chemicals Pvt. Ltd., Dombivali, Dist Thane, (MH) A New Herbicide molecule evaluation on maize.
PAU, Lidhiana	• AINP on Organic Farming (NPOF)	• Organically raised sugarcane-ratoon system trial
TNAU, Coimbatore	• ATMA	• Study of the weed dynamics in the on-Station IFS Research.
UAS, Bengaluru	• Staff Training Unit, UAS Bengaluru • ICAR-National Bureau of Agriculturally Important Insects	• Providing training on weed management to staff of Extension personnel of the University, Farmers, Farm women and Input dealers, Development Departments of the State Governments and Central Governments etc. • Bio-control agents for release to control Parthenium and water hyacinth.
PJTSAU, Hyderabad	• ICAR-CRIDA • ICAR-IIRR • AICRP on Maize • AICRP on Groundnut • AICRP on Rice • AICRP-FIM • AICRP on IFS • NIPHM • MANAGE	• Evaluation of impact of elevated CO¬2 and temperature on crop and weed interaction, dynamics and herbicide bio-efficacy • The microbial dynamics in CA systems and soil microbiome analysis • Herbicide application in maize with Drones • Palem in conducting trials on “herbicide application in groundnut with Drones • Identifying suitable nozzles to be used for application of herbicides with drones • IFS models developed by AICRP on IFS • IWM in various crops and cropping systems • IWM in crops and cropping systems, herbicide residues and ecological impact of herbicides, etc

7 PUBLICATIONS

Research Papers

AAU, Anand

Chaudhari D.D., Patel, V. J., Patel H. K. and Patel B. D. 2023. Integrated weed management to manage complex weed flora in turmeric. *Indian Journal of Weed Science* **55**(2): 190-192.

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UAS, Bengaluru

B. M. Gurubasavaswamy, K. N. Geetha, S. Kamala Bai, N. Pruthviraj, A. N. Karthi, J. K. Sinchana and C. R. Tejaswini 2023, Weed management in organic Kodo millet in Eastern dry zone of Karnataka, *Indian Journal of Weed Science*, **55**(3), 355-358.

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CCSHAU, Hisar-

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Publication and students guided by the coordinating centres during 2023-24

Sl no.	Centre Name	Research Paper	Popular articles	Paper presented/seminars/symposia/conferences	Books	Books Chapter	Lecture delivered during training	M.Sc.	Ph.D
1	PAU, Ludhiana	12	5	4	0	0	0	6	4
2	UAS, Bengaluru	3	0	2	0	0	0	8	0
3	RVSKVV, Gwalior	1	3	0	0	1	0	2	5
4	GBPUAT, Pantnagar	2	0	2	0	0	0	5	4
5	CSKHPKV, Palampur	12	0	3	2	5	35	0	0
6	AAU, Jorhat	0	2	5	0	1	5	3	5
7	AAU, Anand	4	2	3	0	2	21	3	2
8	TNAU, Coimbatore	2	2	1	0	0	5	5	6
9	KAU, Thrissur	0	3	6	0	0	9	6	1
10	OUAT, Bhubaneshwar	0	0	0	0	0	0	4	2
11	PJTSAU, Hyderabad	8	8	1	0	0	4	1	3
12	CCSHAU, Hisar	6	3	17	0	0	7	2	0
13	IGKV, Raipur	9	0	2	1	0	0	3	6
14	PDKV, Akola	0	0	0	0	0	0	1	0
15	BCKV, Kalyani	1	0	0	0	0	0	4	5
16	MPUAT, Udaipur	0	4	0	0	0	0	11	9
17	SKUAST, Jammu	3	0	0	2	4	14	2	0
	Total	**63**	**32**	**46**	**5**	**13**	**100**	**66**	**52**

8 AWARDS AND RECOGNITIONS

Centre Name	Awards and Recognitions	Venue and Date	Name of the Scientist
GBPUAT, Pantnagar	Faculty Excellence Award for Significant contribution in the field of research and extension during the year 2023	GBPUAT, Pantnagar , 2023	Dr. S.P. Singh
KAU, Thrissur	Best research paper award (oral presentation: Runner up) National Conference on Tropical Tuber Crop for Sustainability, Tradition, Agri-Food Systems and Resilience, Organized by Indian Society for Root Crops	Trivandrum, 28-29 November ,2023	Dr. P Prameela Dr. Savitha Antony
PAU, Ludhiana	Scientist of the Year Award-2023 in International Conference "One Health-One Word" organised by Rajmata Vijayaraje Scindia Krishi Vishwa-vidyalaya (RVSKVV), Gwalior, Madhya Pradesh in collaboration with ICAR-IISS Bhopal, AIIMS Bhopal.	Gwalior, 28-29 December, 2023	Dr. Pervinder Kaur
SKUAST, Jammu	Best oral presentation award on sustainable agronomic interventions for fodder management of small ruminants and current advances in precision farming and nanotechnology for sustainable agricultural management	Baramulla, J&K, India and July 2023	Dr. Manpreet Kour
	Woman Scientist award, 2 days international conference on current advances in agriculture, animal husbandry and allied sciences (CAAAAS -2023) HELD ON 1O-11TH July, 2023 organized by ARCN, Mabushi, Abuja, Nigeria and NADCL,	Baramulla, J&K, India and July 2023	Dr. Manpreet Kour
	Best Agronomist Award 1st International Agriculture Conference on Natural VS Organic farming: In context to Bhartiya Agriculture Gujrat Natural Farming and Science University, Anand Hindustan Agricultural Research Welfare Society and IIMTU	Meerut , 24-26 December 2023 .	Dr. Manpr eet Kour
UAS, Bengaluru	Best centre award, AICRP-WM ICAR-DWR Jabalpur, XXX Annual Review Meeting held at Shar-e-Kashmir University of Agricultural Sciences & Technology	Jammu during 26th May, 2023	Dr. (Mrs.) K. N. Geetha Dr. (Mrs.) Kamala Bai S

9 RECOMMENDATION OF AICRP-WM ANNUAL REVIEW MEETING

Recommendations emerged out of the XXX Annual Review Meeting of AICRP-Weed Management held during 26-27 May 2023 at SKUAST, Jammu.

1. Carry out impact assessment of weed management technologies developed by the centre on the basis of area of adoption, productivity gains and monetary benefits at the state / country level.
2. Develop information on weeds of national impotence.
3. Estimation of wheat area (district Wise) in Panjab and Haryana infested with herbicide resistant biotype of *Phalaris minor*, and the impact of weed management technologies on increasing Wheat productivity and income or reducing Yield losses due to *P. minor* in these two states.
4. Study the feasibility of tar-water technology in direct-seeded rice (DSR) Developed at PAU, Ludhiana.
5. The coordinating centre need to develop weed management technology under organic farming.
6. Each coordinating centre to take efforts to make 1-2 villages Parthenium-free with the help of some funds allocated for national mission of Sawachhta under MGNREGA.
7. Publish the weed management technologies and success stories developed by the coordinating centres in the form of technical bulletins on regional-basis, jointly with ICAR-DWR.

●●●

10 STATUS OF EXPERIMENTS CONDUCTED

S.NO.	Centres	WP-1 Development of location specific sustainable weed Management Practices	WP-2 Management of weed in non -cropped and aquatic area	WP-3 Fate of herbicides residues in Different Eco-Systems	WP-4 Demonstration and impact assessment of weed management technologies & SCSP	ST-Station Trails on Weed management	Total No. Number of Experiment
1.	PAU, Ludhiana	WP1.2.3, WP 1.3.13, WP-1.5.1	WP 2.8 WP 2.10	WP 3.1, WP 3.2, WP 3.3, WP 3.4	WP 4.1, WP 4.2, WP 4.3	ST-1.1.14, ST-1.1.15	14
2.	UAS, Bengaluru	WP-1.1.2, WP-1.1.4, WP-1.1.5, WP1.2.3, WP 1.3.1, WP-1.4.4	WP 2.4 WP 2.8 WP 2.9 WP 2.10	WP 3.1* WP 3.2* WP 3.3*	WP 4.1, WP 4.3	ST-1.1.9	16
3.	RVSKVV, Gwalior	WP-1.1.3, WP-1.1.7, WP1.2.3, WP 1.3.14, WP-1.4.5	WP 2.8 WP 2.10	-	WP 4.1, WP 4.1, WP 4.2, WP 4.3 WP 4.4*	-	12
4.	GBPUAT, Pantnagar	WP-1.1.1, WP1.2.1, WP 1.3.4, WP-1.5.1	WP 2.8 WP 2.10	-	WP 4.1 ; WP 4.2 , WP 4. 3, WP 4. 4*	-	10
5.	CSKHPKV, Palampur	WP-1.1.2, WP-1.1.5, WP 1.2.4, WP 1.3.3	WP 2.3, WP 2.8* WP 2.10	WP 3.1, WP 3.2, WP 3.3 , WP 3.4	WP 4.1, WP 4.2, WP 4.3, WP 4.4	ST-1.1.6, ST-1.1.7	17
6.	AAU, Jorhat	WP 1.3.11 WP-1.4.7*	WP 2.1, WP 2.2 *, WP 2.10 *	-	WP 4.1* WP 4.3 WP 4.4*	ST1.1.2*, ST1.1.3* ST-1.1.20	11
7.	AAU, Anand	WP 1.2.5, WP 1.3.2, WP 1.4.6	WP 2.8 WP 2.10	WP 3.2, WP 3.3	WP 4.1, WP 4.2, WP 4.3	ST-1.1.12 ST-1.1.13	12
8.	TNAU, Coimbatore	WP 1.2.5, WP 1.3.9, WP 1.4.3	WP 2.8 WP 2.10*	WP 3.1, WP 3.2, WP 3.3 WP 3.4	WP 4.1, WP 4.2, WP 4.3, WP 4.4	ST-1.1.1	14

contd. .....

9.	KAU, Thrissur	WP 1.3.6, WP-1.4.8, WP-1.5.3*	WP 2.4, WP 2.5, WP 2.6, WP 2.8 WP 2.10	WP 3.1*	WP 4.1, WP 4.2, WP 4.3, WP 4.4	ST-1.1.4a, ST-1.1.4b, ST-1.1.5	16
10.	OUAT, Bhubaneswar	WP-1.1.2, WP-1.1.6*, WP1.2.2, WP 1.3.1, WP 1.4.1	WP 2.4* WP 2.8 * WP 2.10	-	WP 4.1, WP 4.2 , WP 4.3 WP 4.4	-	12
11.	PJTSAU, Hyderabad	WP-1.1.3 WP-1.1.7 WP 1.2.5 WP 1.3.8	WP 2.8* WP 2.10	WP3.1 WP 3.2, WP 3.3, WP 3.4*	WP 4.1, WP 4.2, WP 4.3	ST-1.1.11 *	14
12.	CCSHAU, Hisar	WP-1.1.1, WP1.2.1, WP1.2.3, WP1.4.2, WP1.5.1	WP 2.7 , WP 2.8* WP 2.10	WP 3.1* WP 3.2* WP 3.3*	WP 4.1, WP 4.2 *, WP 4.3 WP 4.4	ST-1.1.19	16
13.	IGKV, Raipur	WP-1.1.2, WP-1.1.4, WP-1.2.2, WP-1.3.5, WP-1.5.2	WP 2.7 WP 2.8 WP 2.10	-	WP 4.1, WP 4.2 WP 4.3 *	-	11
14.	PDKV, Akola	WP-1.1.5, WP-1.1.6* WP-1.3.7	WP 2.7* WP 2.8* WP 2.10*	-	WP 4.1, WP 4.2, WP 4.3*	ST-1.1.10	10
15.	BCKV, Kalyani	WP-1.1.2, WP-1.1.5, WP-1.1.6, WP-1.1.7, WP-1.2.2*	WP 2.4, WP 2.8 * WP 2.10*	WP 3.1 *, WP 3.3 *	WP 4.1, WP 4.3* WP 4.4 *	-	13
16.	MPUAT, Udaipur	WP-1.1.3, WP-1.1.5, WP-1.1.7, WP-1.2.4, WP-1.3.10, WP-1.4.1	WP 2.8 WP 2.10	-	WP 4.1, WP 4.2, WP 4.3 WP 4.4	ST-1.1.8	13
17.	SKUAST, Jammu	WP-1.1.1, WP1.2.1, WP1.3.12, WP1.5.1, WP1.5.4	WP 2.8, WP 2.10	-	WP 4.1, WP 4.2, WP 4.3 , WP 4.4	-	11

***Not Reported**

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12 STATUS OF SUBMISSION OF ANNUAL REPORT 2023

Sl.No.	Centre's Name	Received	
		Before due date (25.01.2024)	After due date
Regular Centres			
1.	PAU, Ludhiana	-	28.01.2024
2.	UAS, Bengaluru	20.01.2024	-
3.	RVSKVV, Gwalior	-	31.01.2024
4.	GBPUAT, Pantnagar	25.01.2024	-
5.	CSKHPKV, Palampur	17.01.2024	-
6.	AAU, Jorhat	-	19.02.2024
7.	AAU, Anand	25.01.2024	-
8.	TNAU, Coimbatore	10.01.2024	-
9.	KAU, Thrissur	06.01.2024	-
10.	OUAT, Bhubaneshwar	-	01.02.2024
11.	PJTSAU, Hyderabad	25.01.2024	-
12.	CCSHAU, Hisar	-	26.01.2024
13.	IGKV, Raipur	25.01.2024	-
14.	PDKV, Akola	25.01.2024	-
15.	BCKV, Kalyani	-	29.01.2024
16.	MPUAT, Udaipur	25.01.2024	-
17.	SKUAST, Jammu	-	12.03.2024
Volunteer Centres			
1.	SKUAST, Kashmir	24.01.2024	-
2.	BAU, Sabour	22.01.2024	-
3.	PAJNCOA&RI Puducherry	-	31.01.2024
4.	UAS, Dharwad	-	01.02.2024
5.	BUAT, Banda	22.01.2024	-
6.	ANGRAU, Guntur	-	26.02.2024
7.	SKNAU, Jobner	-	29.01.2024

Rice: Kharif-2023

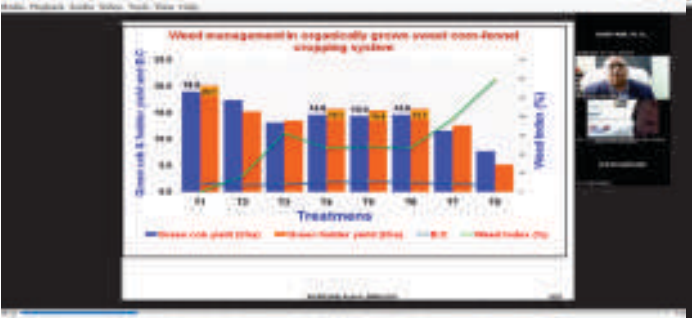
-In conservation tillage experiment, conventional tillage + residue resulted in significantly lowest weed biomass and higher grain yield of rice. However, it was statistically at par with zero-tillage + residue in respect to yields of wheat. The highest net returns and B:C ratio were observed in zero-tillage + residue in rice crop.

-Among the weed management treatments, lowest weed density, weed biomass and highest grain/straw yields and B:C ratio were observed in IWM treatment (pendimethalin 678 g/ha fb bispyribac-sodium 25 g/ha (20 DAS) fb hand weeding (40 DAS) fb weed seed harvest.

Wheat Rabi-2023-24 (ongoing)
Date of sowing: 15 Nov 2023
Variety: DBW-222
Major weed flora observed: Phalaris minor, Anagallis arvensis, Medicago denticulata, Rumex dentatus, Melilotus spp. (Dicot native and Rumex spp.

Respected Dr J.S. Mishra, Director, ICAR-IIWR visited the AICRP-WM, Raipur Centre on 29.01.2024

THANK YOU



ST 2 (v): Weed management in direct dry seeded rice under irrigated condition

- Harvesting of rice and sowing of bioassay was done on 25-11-2023
- Statistical analysis and preparation of report of the experiment

Following treatments were found effective for the management of complex weed flora in dry direct seeded rice under middle Gujarat condition with higher gross return, net return and B:C

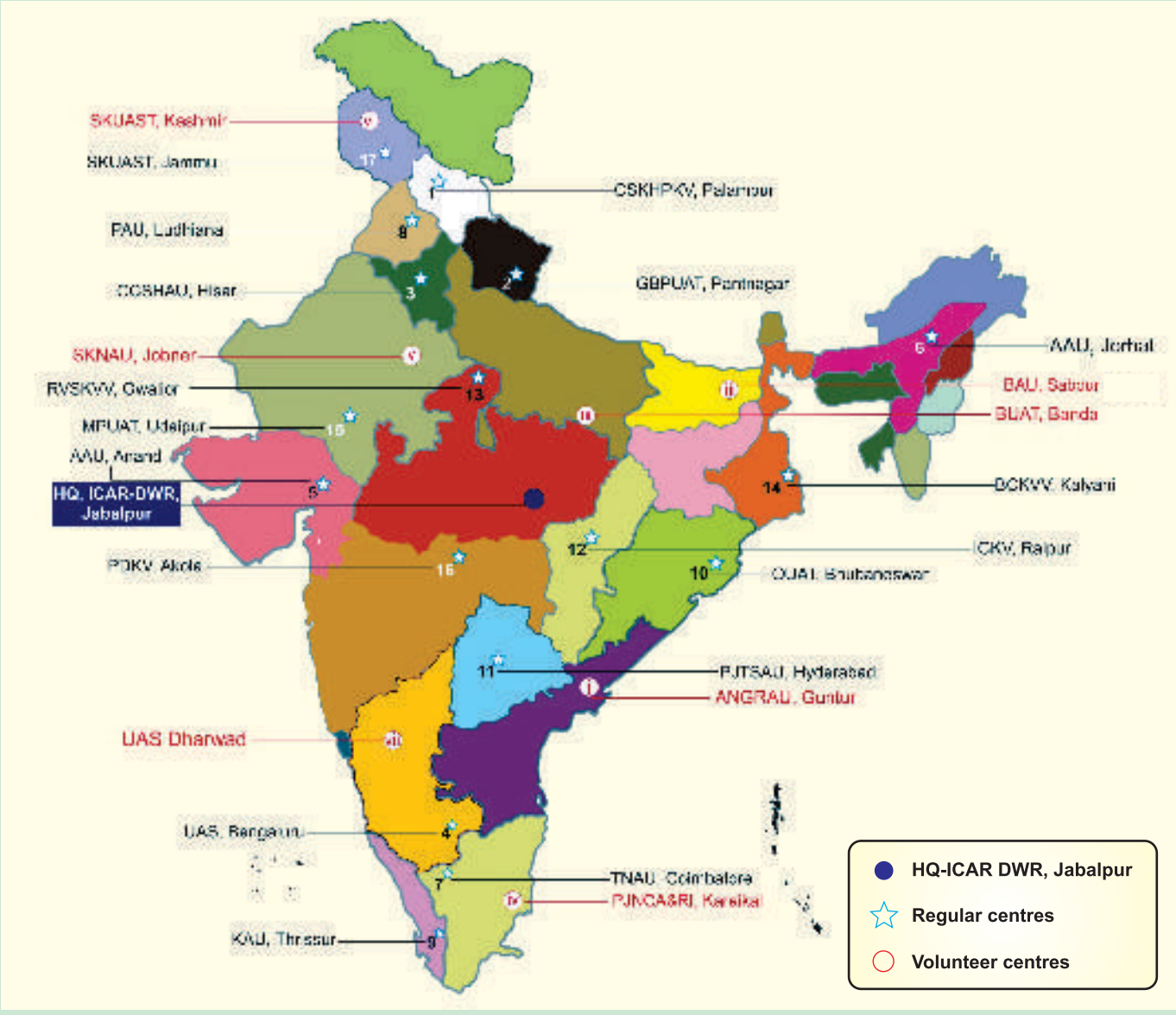
- Hand weeding carried out at 20 and 40 DAS
- Pretilachlor 30% + pyrazosulfuron-ethyl 0.75% WG 600+15 g/ha PE (PM) fb HW at 30 DAS
- triafamone 20% + ethoxysulfuron 10% WG 44.0+22.5 g/ha EPoE (PM) fb HW at 30 DAS
- penoxsulam 1.02% + cyhalofop-butyl 5.1% OD 120 g/ha EPoE (PM) fb HW at 30 DAS and
- Bispyribac-sodium 20% + pyrazosulfuron-ethyl 15% WDG 35 g/ha EPoE (premix) fb HW at 30 DAS

AICRP-WM Award: DRM-2020

Effect of treatments on yield, B:C and WCE in DSR

Sr. No.	Treatment	Pod yield (kg/ha)	Haulm yield (kg/ha)	B:C	WCE (%) at harvest
T1		5.84a	7.73a	1.88	82.0
T2		4.38c	6.69bc	1.66	67.4
T3		3.81de	6.30c	1.48	58.3
T4		3.58e	6.04c	1.32	64.8
T5		2.47f	4.46d	0.74	29.0
T6		5.46a	7.63ab	1.92	67.8
T7		5.74a	8.07a	2.01	92.3
T8		5.03b	6.92b	1.59	72.6
T9		5.84a	7.77a	1.71	64.1
T10		0.36f	0.60e	0.16	-

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद
Agrisearch with a human touch



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